

EPSON

SCARA ROBOT

G10 / G20 series

MANIPULATOR MANUAL

Rev.2

EM082R1662F

MANIPULATOR MANUAL G10 / G20 series Rev.2

SCARA ROBOT

G10 / G20 series Manipulator Manual

Rev.2

FOREWORD

Thank you for purchasing our robot products.

This manual contains the information necessary for the correct use of the manipulator.

Please carefully read this manual and other related manuals before installing the robot system.

Keep this manual handy for easy access at all times.

WARRANTY

The Manipulator and its optional parts are shipped to our customers only after being subjected to the strictest quality controls, tests, and inspections to certify its compliance with our high performance standards.

Product malfunctions resulting from normal handling or operation will be repaired free of charge during the normal warranty period. (Please ask your Regional Sales Office for warranty period information.)

However, customers will be charged for repairs in the following cases (even if they occur during the warranty period):

1. Damage or malfunction caused by improper use which is not described in the manual, or careless use.
2. Malfunctions caused by customers' unauthorized disassembly.
3. Damage due to improper adjustments or unauthorized repair attempts.
4. Damage caused by natural disasters such as earthquake, flood, etc.

Warnings, Cautions, Usage:

1. If the Manipulator or associated equipment is used outside of the usage conditions and product specifications described in the manuals, this warranty is void.
2. If you do not follow the WARNINGS and CAUTIONS in this manual, we cannot be responsible for any malfunction or accident, even if the result is injury or death.
3. We cannot foresee all possible dangers and consequences. Therefore, this manual cannot warn the user of all possible hazards.

TRADEMARKS

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NOTICE

No part of this manual may be copied or reproduced without authorization.

The contents of this manual are subject to change without notice.

Please notify us if you should find any errors in this manual or if you have any comments regarding its contents.

INQUIRIES

Contact the following service center for robot repairs, inspections or adjustments.

If service center information is not indicated below, please contact the supplier office for your region.

Please prepare the following items before you contact us.

- Your controller model and its serial number
- Your manipulator model and its serial number
- Software and its version in your robot system
- A description of the problem

SERVICE CENTER

| |
|--|
| |
|--|

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Before Reading This Manual

This section describes what you should know before reading this manual.

Structure of Control System

The G10 / G20 series Manipulators can be used with the following combinations of Controllers and software.

The operating methods and descriptions are different depending on which software you are using. The following icons are put beside appropriate text as necessary. Use the descriptions that pertain to the software you are using.

Controller : RC180

Software : EPSON RC+ 5.0 Ver. 5.2 or later

For details on commands, refer to User's Guide or "On-line help".

Turning ON/OFF Controller

When you see the instruction "Turn ON/OFF the Controller" in this manual, be sure to turn ON/OFF all the hardware components. For the Controller composition, refer to the table above.

Shape of Motors

The shape of the motors used for the Manipulator that you are using may be different from the shape of the motors described in this manual because of the specifications.

Setting by Using Software

This manual contains setting procedures by using software. They are marked with the following icon.

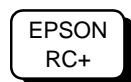


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Setup & Operation

This volume contains information for setup and operation of the G10 / G20 series Manipulators.

Please read this volume thoroughly before setting up and operating the Manipulators.




1. Safety

Installation and transportation of robots and robotic equipment shall be performed by qualified personnel and should conform to all national and local codes. Please read this manual and other related manuals before installing the robot system or before connecting cables.

Keep this manual handy for easy access at all times.

1.1 Conventions

Important safety considerations are indicated throughout the manual by the following symbols. Be sure to read the descriptions shown with each symbol.


| | |
|---|--|
|  WARNING | This symbol indicates that a danger of possible serious injury or death exists if the associated instructions are not followed properly. |
|  WARNING | This symbol indicates that a danger of possible serious injury or death caused by electric shock exists if the associated instructions are not followed properly. |
|  CAUTION | This symbol indicates that a danger of possible harm to people or physical damage to equipment and facilities exists if the associated instructions are not followed properly. |

1.2 Design and Installation Safety

Only trained personnel should design and install the robot system. Trained personnel are defined as those who have taken robot system training and maintenance training classes held by the manufacturer, dealer, or local representative company, or those who understand the manuals thoroughly and have the same knowledge and skill level as those who have completed the training courses.

To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the *Installation and Design Precautions* in the *Safety* chapter of the *EPSON RC+ User's Guide*.




The following items are safety precautions for design personnel:

| | |
|--|---|
|  <p>WARNING</p> | <ul style="list-style-type: none">■ Personnel who design and/or construct the robot system with this product must read the <i>Safety</i> chapter in the <i>EPSON RC+ User's Guide</i> to understand the safety requirements before designing and/or constructing the robot system. Designing and/or constructing the robot system without understanding the safety requirements is extremely hazardous, may result in serious bodily injury and/or severe equipment damage to the robot system, and may cause serious safety problems.■ The Manipulator and the Controller must be used within the environmental conditions described in their respective manuals. This product has been designed and manufactured strictly for use in a normal indoor environment. Using the product in an environment that exceeds the specified environmental conditions may not only shorten the life cycle of the product but may also cause serious safety problems.■ The robot system must be used within the installation requirements described in the manuals. Using the robot system outside of the installation requirements may not only shorten the life cycle of the product but also cause serious safety problems. |
|--|---|

Further precautions for installation are mentioned in the chapter *Setup & Operation: 3. Environments and Installation*. Please read this chapter carefully to understand safe installation procedures before installing the robots and robotic equipment.

1.3 Operation Safety

The following items are safety precautions for qualified Operator personnel:

| | |
|---|---|
|  WARNING | <ul style="list-style-type: none"> ■ Please carefully read the <i>Safety-related Requirements</i> in the <i>Safety</i> chapter of the <i>EPSON RC+ User's Guide</i> before operating the robot system. Operating the robot system without understanding the safety requirements is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system. ■ Do not enter the operating area of the Manipulator while the power to the robot system is turned ON. Entering the operating area with the power ON is extremely hazardous and may cause serious safety problems as the Manipulator may move even if it seems to be stopped. ■ Before operating the robot system, make sure that no one is inside the safeguarded area. The robot system can be operated in the mode for teaching even when someone is inside the safeguarded area. The motion of the Manipulator is always in restricted (low speeds and low power) status to secure the safety of an operator. However, operating the robot system while someone is inside the safeguarded area is extremely hazardous and may result in serious safety problems in case that the Manipulator moves unexpectedly. ■ Immediately press the Emergency Stop switch whenever the Manipulator moves abnormally while the robot system is operated. |
|  WARNING | <ul style="list-style-type: none"> ■ To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Do not insert or pull out the motor connectors while the power to the robot system is turned ON. Inserting or pulling out the motor connectors with the power ON is extremely hazardous and may result in serious bodily injury as the Manipulator may move abnormally, and also may result in electric shock and/or malfunction of the robot system. |
|  CAUTION | <ul style="list-style-type: none"> ■ Whenever possible, only one person should operate the robot system. If it is necessary to operate the robot system with more than one person, ensure that all people involved communicate with each other as to what they are doing and take all necessary safety precautions. |

1.4 Emergency Stop

If the Manipulator moves abnormally during operation, immediately press the Emergency Stop switch. Stops the power supply to the motor, and the arm stops in the shortest distance with the dynamic brake and mechanical brake.

However, avoid pressing the Emergency Stop switch unnecessarily while the Manipulator is running normally. Otherwise, the Manipulator may hit the peripheral equipment since the operating trajectory while the robot system stops is different from that in normal operation.

To place the system in emergency mode during normal operation, press the Emergency Stop switch when the Manipulator is not moving.

Refer to the Controller manual for instructions on how to wire the Emergency Stop switch circuit.

Free running distance in emergency

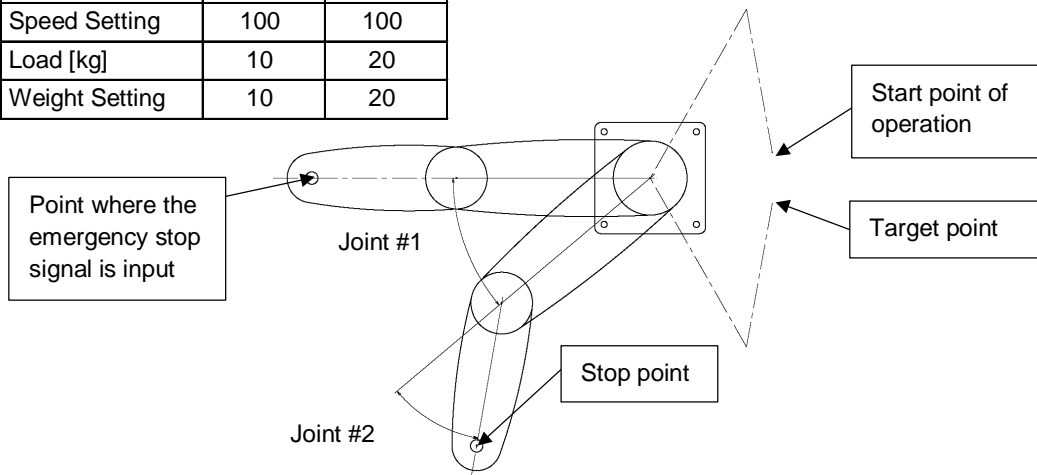
The operating Manipulator cannot stop immediately after the Emergency Stop switch is pressed.

The free running time/angle/distance of the Manipulator are shown below. However, remember that the values vary depending on following conditions.

Weight of the end effector Weight of work piece Operating pose
 Weight Speed Accel etc.

Conditions for Measurement

| | G10 | G20 |
|----------------|-----|-----|
| Accel Setting | 100 | 100 |
| Speed Setting | 100 | 100 |
| Load [kg] | 10 | 20 |
| Weight Setting | 10 | 20 |



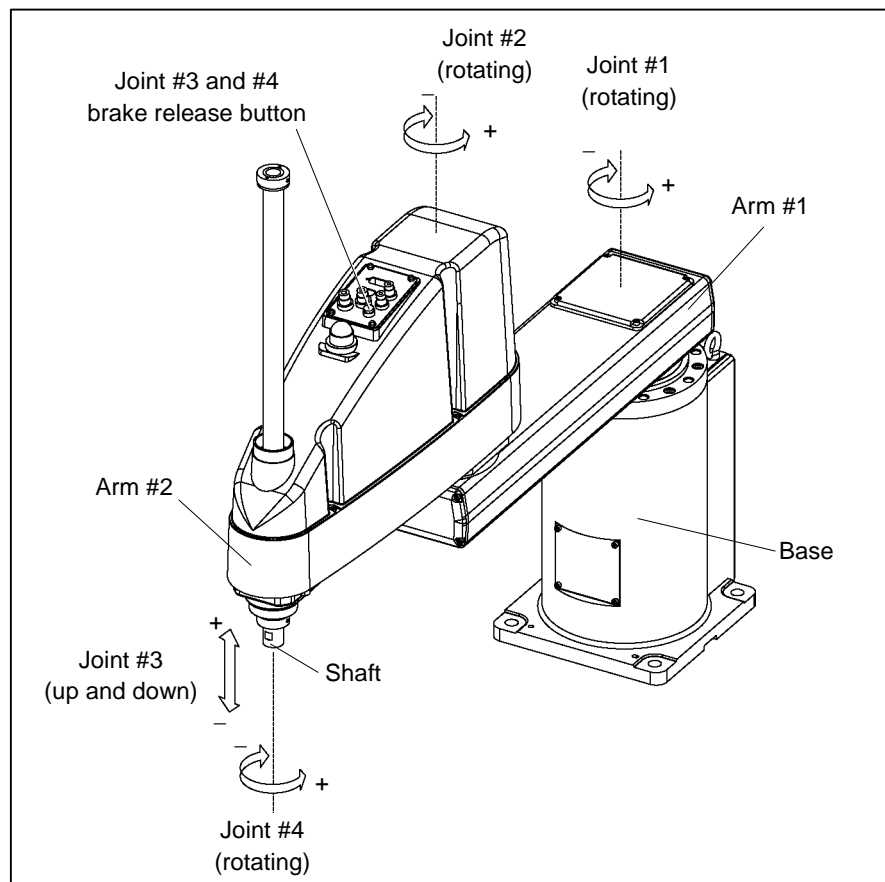
| Controller | | RC180 | |
|-----------------------|-----------------------------|-----------|-----------|
| Manipulator | | G10-85*** | G20-A0*** |
| Free running time | Joint #1 + Joint #2 [sec.] | 0.7 | 1.3 |
| | Joint #3 [sec.] | 0.5 | 0.8 |
| Free running angle | Joint #1 [deg.] | 70 | 110 |
| | Joint #2 [deg.] | 50 | 50 |
| | Joint #1 + Joint #2 [deg.] | 120 | 160 |
| Free running distance | Joint #3 G10/G20-***1**[mm] | 80 | 90 |
| | G10/G20-***4** | 160 | 170 |


Contact us for details of G10-65*** or G20-85***.

1.5 Emergency Movement Without Drive Power

When the system is placed in emergency mode, push the arm or joint of the Manipulator by hand as shown below:

- Arm #1 Push the arm by hand.
- Arm #2 Push the arm by hand.
- Joint #3 The joint cannot be moved up/down by hand until the electromagnetic brake applied to the joint has been released. Move the joint up/down while pressing the brake release button.
- Joint #4 The shaft cannot be rotated by hand until the electromagnetic brake applied to the shaft has been released. Move the shaft while pressing the brake release button switch.



NOTE  The brake release button affects both Joints #3 and #4. When the brake release button is pressed in emergency mode, the brakes for both Joints #3 and #4 are released simultaneously.

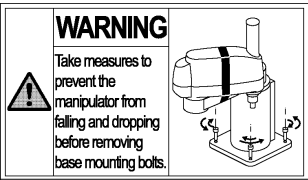
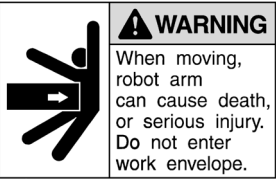


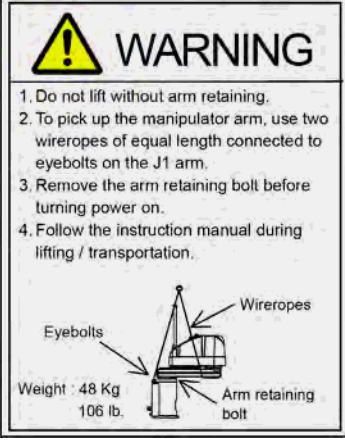
Be careful of the shaft falling and rotating while the brake release button is pressed because the shaft may be lowered by the weight of an end effector.

1.6 Manipulator Labels

The following labels are attached near the locations of the Manipulator where specific dangers exist.

Be sure to comply with descriptions and warnings on the labels to operate and maintain the Manipulator safely.

Do not tear, damage, or remove the labels. Use meticulous care when handling those parts or units to which the following labels are attached as well as the nearby areas:

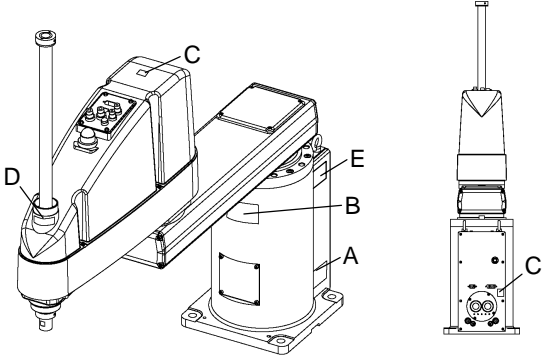
| Location of Labels | Labels | NOTE |
|--------------------|---|---|
| A |  | Before loosening the base mounting screws, hold the arm and secure it tightly with a band to prevent hands or fingers from being caught in the Manipulator. |
| B |  | |
| C |  | Hazardous voltage exists while the Manipulator is ON. To avoid electric shock, do not touch any internal electric parts. |
| D |  | You can catch your hand or fingers between the shaft and cover when bringing your hand close to moving parts. |
| E |  | Only authorized personnel should perform sling work and operate a crane. When these operations are performed by unauthorized personnel, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system. |

NOTE

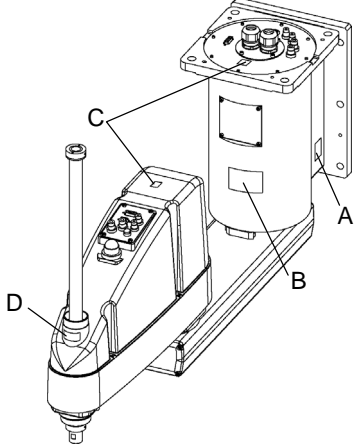


Manipulators with bellows do not have label D for no danger of your hand or fingers being caught.

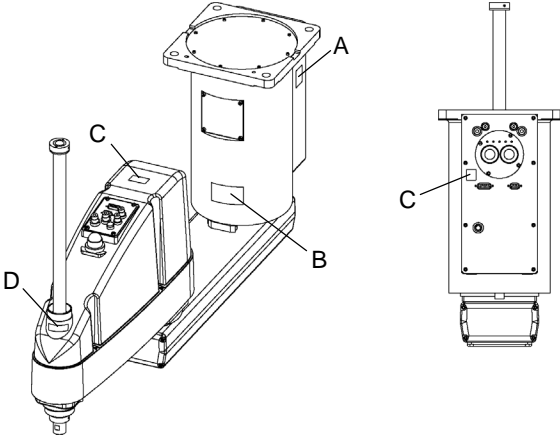
Table Top Mounting: G10/G20-****



Wall Mounting: G10/G20-****W



Ceiling Mounting: G10/G20-****R



2. Specifications

2.1 Features of G10 series and G20 series Manipulators

The G10 series and G20 series Manipulators are high-performance manipulators intended to achieve high speed, high accuracy, space saving, and high cost-performance.

The G10 series Manipulators are optimized for high speed assembly and alignment procedure using multiple-hand.

The G20 series Manipulators are optimized for heavy payload transfer and alignment packing procedure. The 1000 mm long arm model of the G20 series enables wide range motion.

The features of the G10 series and G20 series Manipulators are as follows:

Compatibility with E2H Manipulators (our existing models)

The installation procedure and mounting dimensions of the end effector are compatible with those for the E2H Manipulators (our existing models).

Space Saving

Compactness achieved by using a ductless design.

Reduce the system height by the new short stroke (Z: 180 mm) lineup.

Motion Range Extended

The motion range has been extended by 20% compared to E2 series.

Improved Productivity

The numbers of user wires and pneumatic tubes have been increased.

The speed of Joints #1, 2, 3, and 4 has been enhanced.

Cycle time has been improved.

Increased Load Capacity

The load capacity has been increased to handle greater work load.

G10: Max. 10 kg

G20: Max. 20 kg

Increased Inertia

The available end effector capacity has been enlarged to enable larger multiple-hand that holds multi-kind and different types of work piece.

Allowable moment of inertia has been enlarged according to the load.

G10: Max. 0.25 kgm²

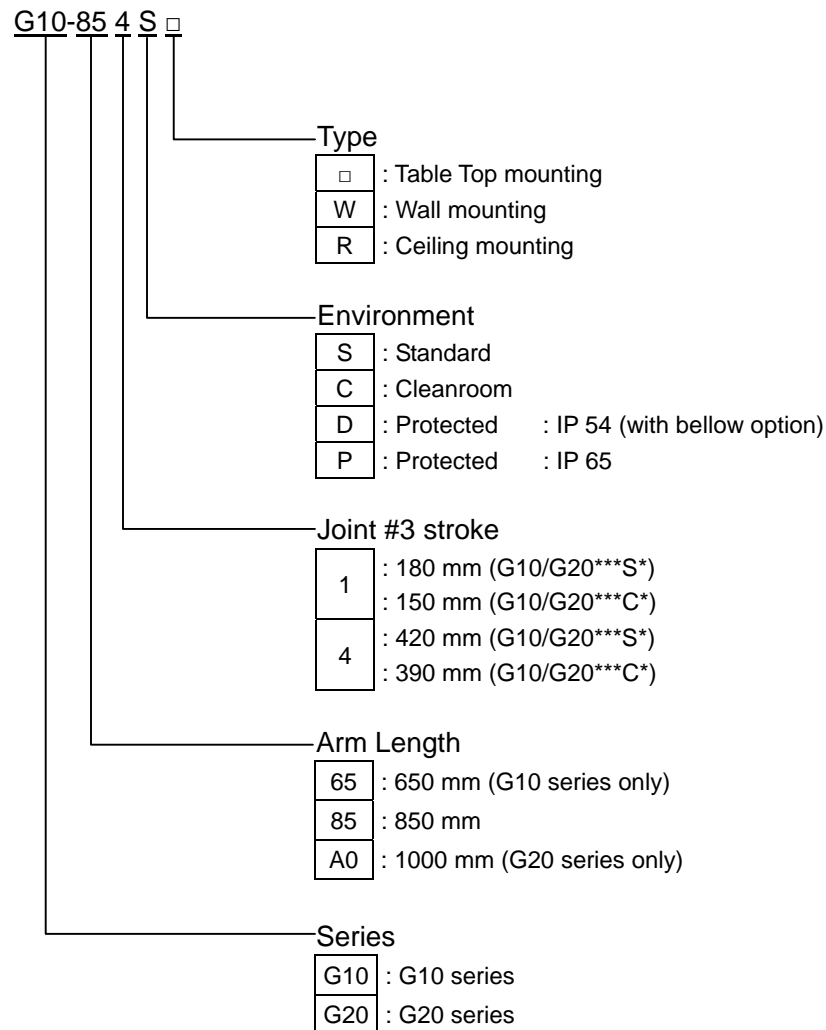
G20: Max. 0.45 kgm²

Various Types Available

Long stroke (Z: 420 mm)

Short stroke (Z: 180 mm)

2.2 Model Number and Model Differences



Environment

Cleanroom-model

Cleanroom-model Manipulator includes additional features that reduce dust emitted by the Manipulator to enable use in clean room environments.

Protected-model (IP54 / IP65)

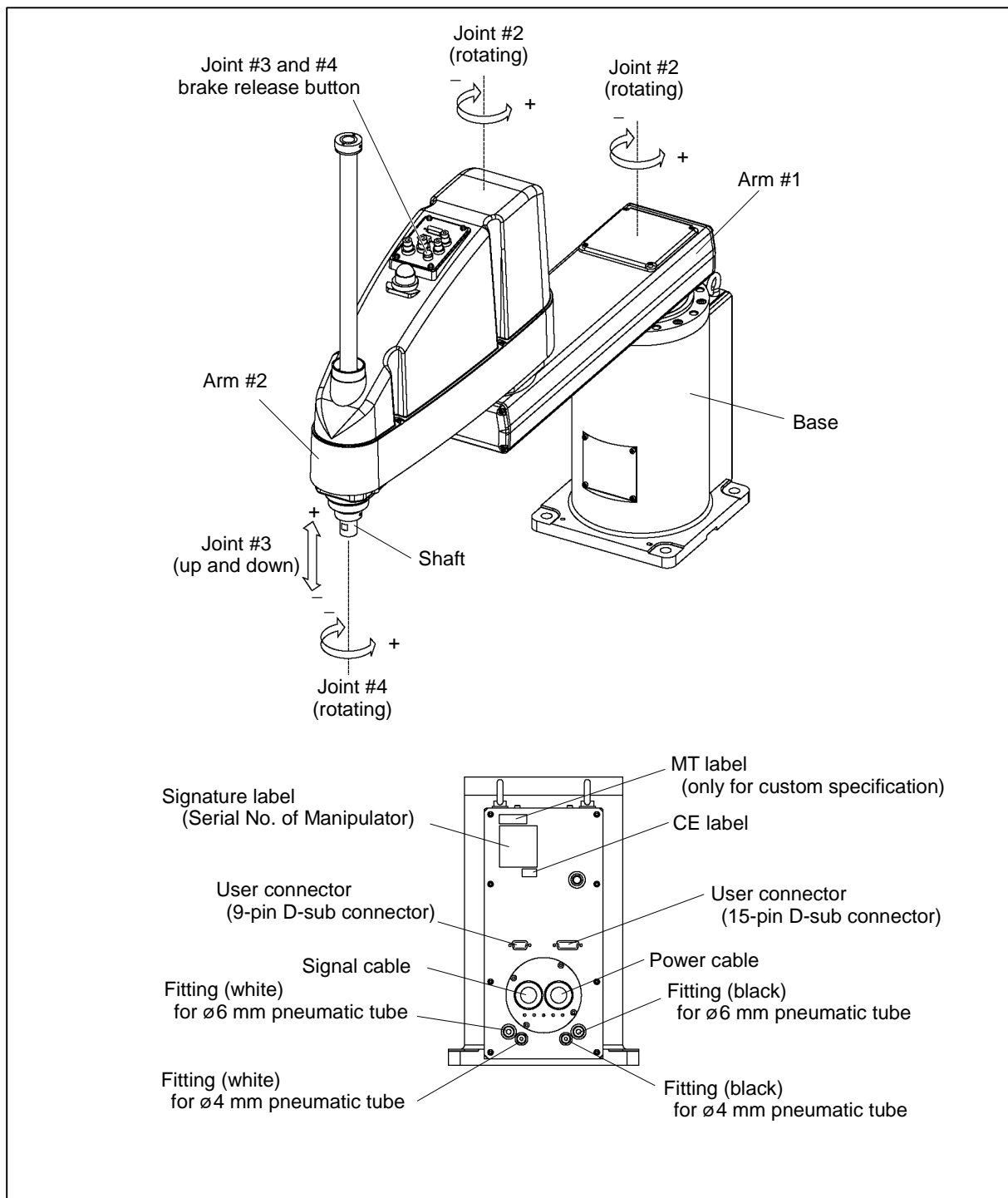
Contact us for detail information regarding the protected-model.


For details on the specifications, refer to *Setup & Operation: 2.4 Specifications*.

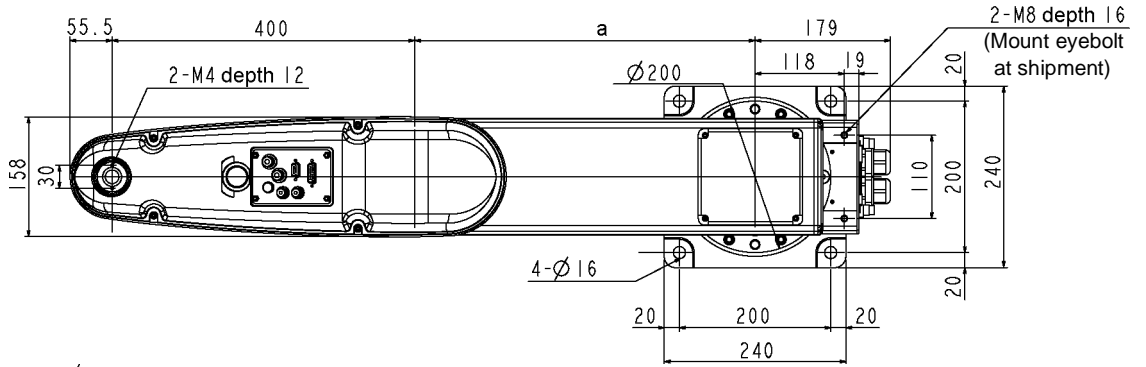
2.3 Part Names and Outer Dimensions

2.3.1 Table Top Mounting

Standard-model : G10/G20-***S

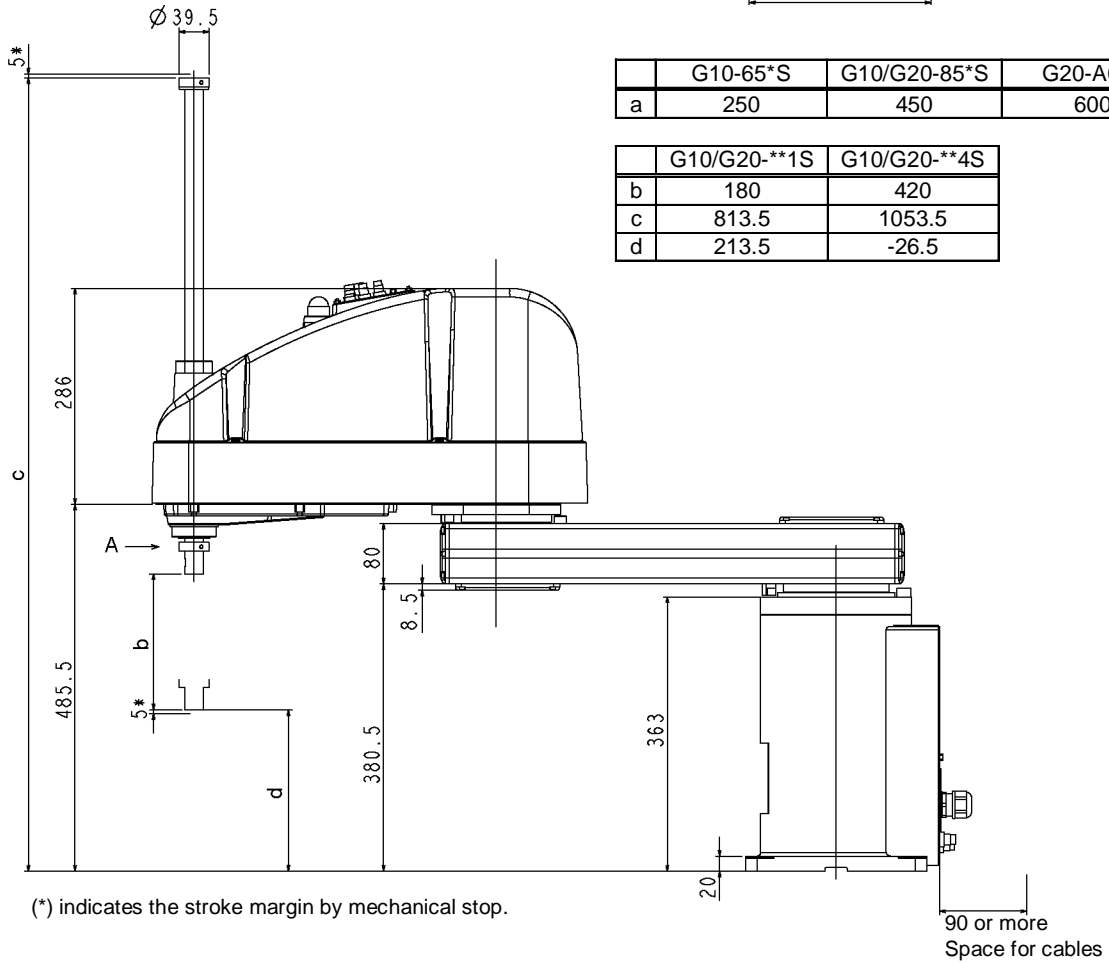


NOTE  The brake release button affects both Joints #3 and #4. When the brake release button is pressed in emergency mode, the brakes for both Joints #3 and #4 are released simultaneously.

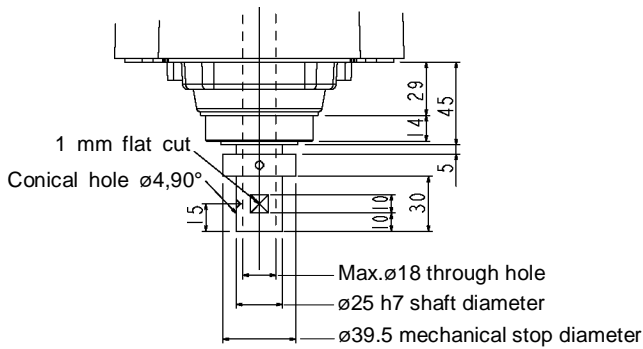


| | G10-65*S | G10/G20-85*S | G20-A0*S |
|---|----------|--------------|----------|
| a | 250 | 450 | 600 |

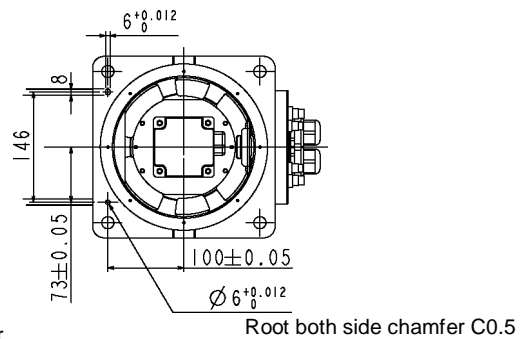
| | G10/G20-**1S | G10/G20-**4S |
|---|--------------|--------------|
| b | 180 | 420 |
| c | 813.5 | 1053.5 |
| d | 213.5 | -26.5 |



(*) indicates the stroke margin by mechanical stop.



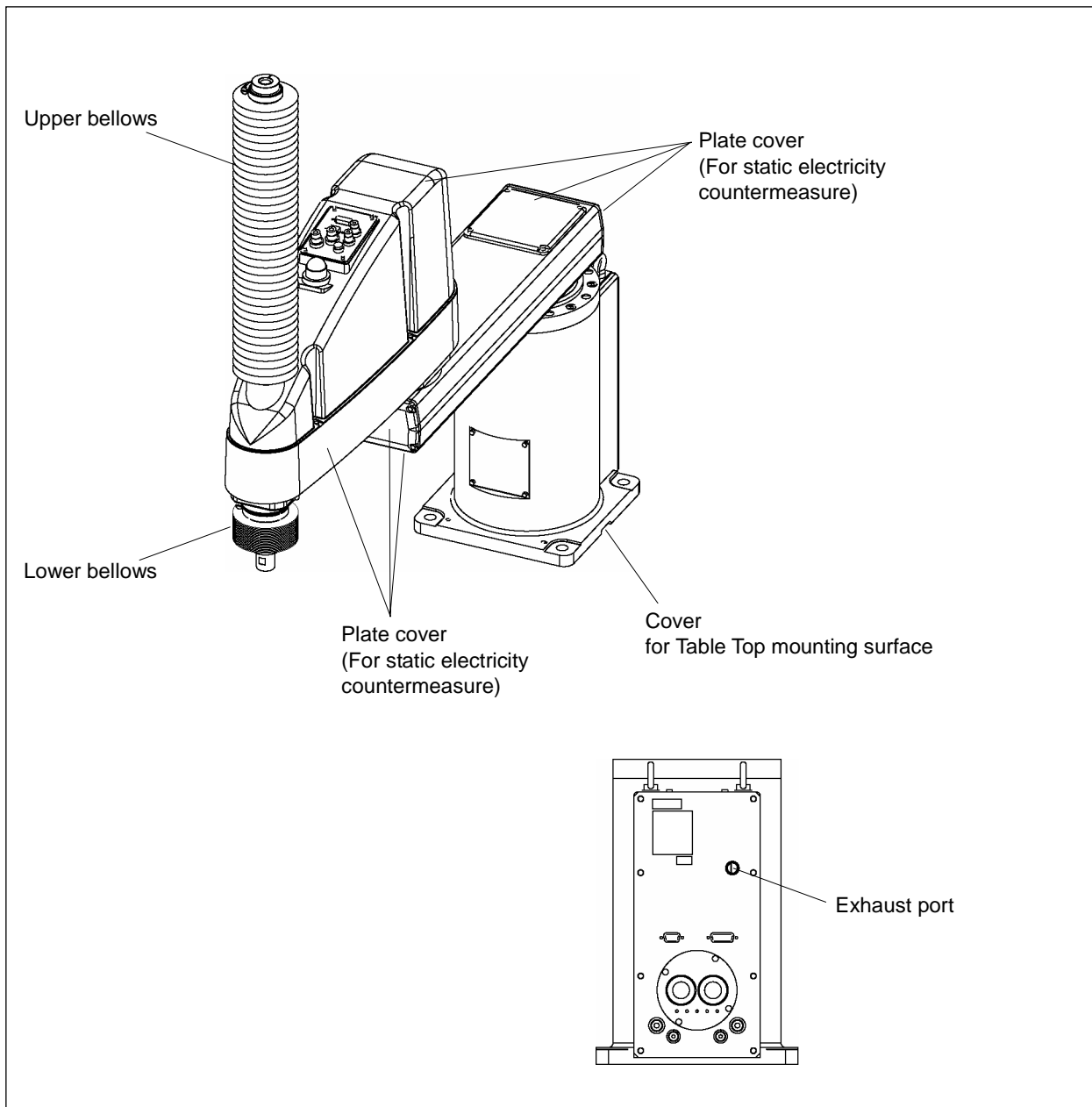
Detail of "A"
(Calibration point position of Joints #3 and #4)

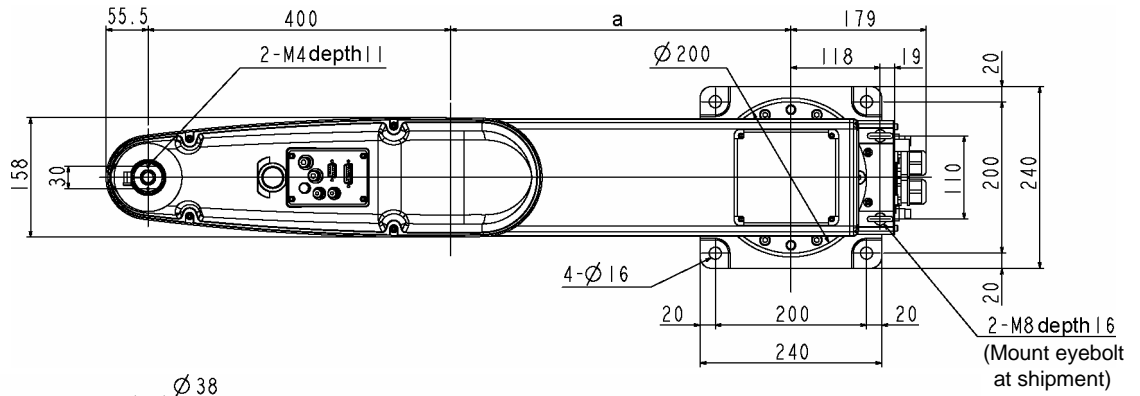


Reference through hole
(View from the bottom of the base)

Cleanroom-model G10/G20-***C

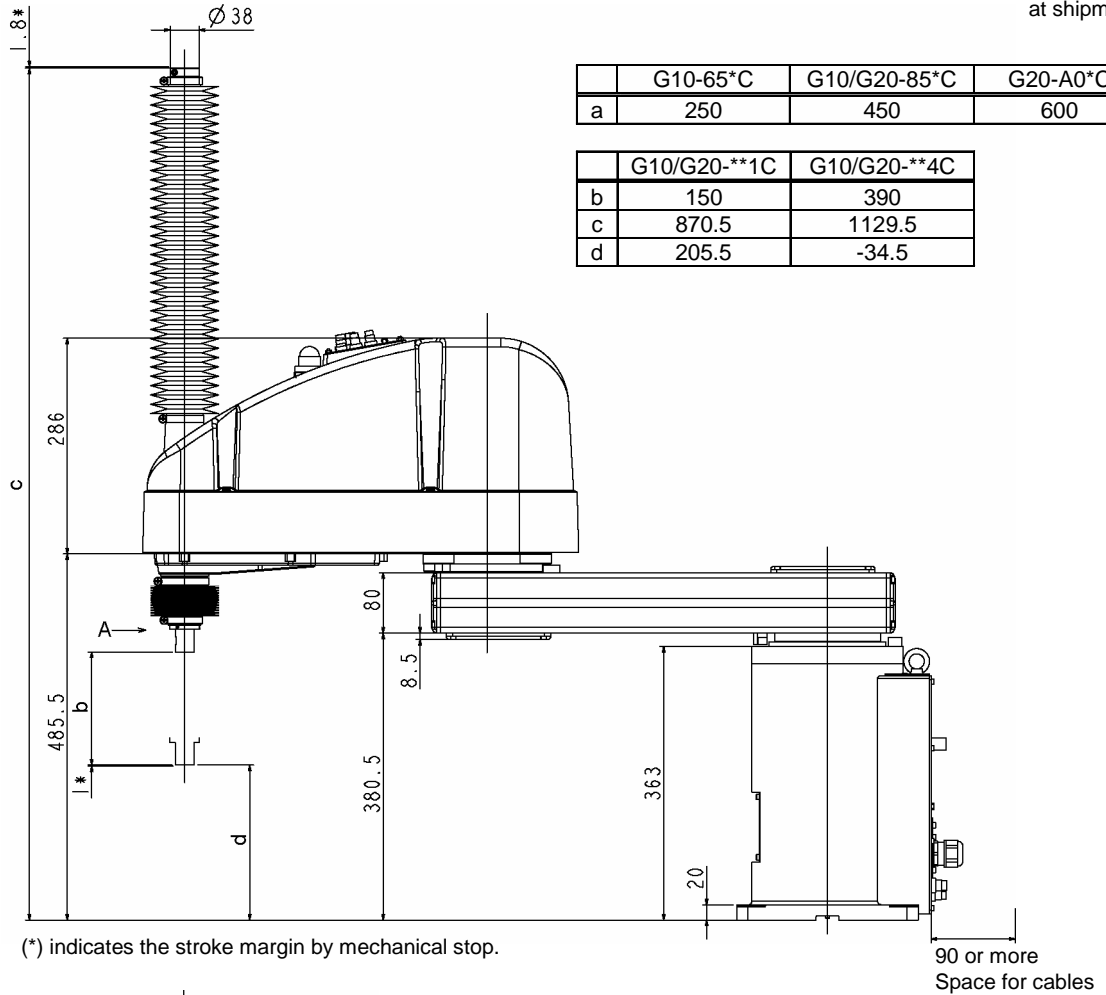
The following figure shows the additional parts and specifications for the Table Top mounting Cleanroom-model when compared with the Standard-model in appearance.



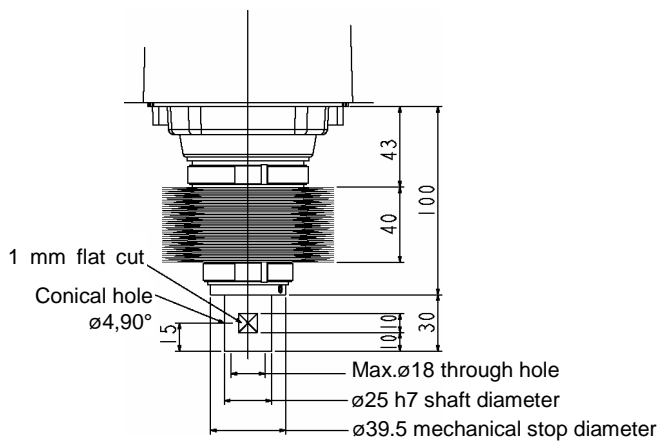


| | G10-65°C | G10/G20-85°C | G20-A0°C |
|---|----------|--------------|----------|
| a | 250 | 450 | 600 |

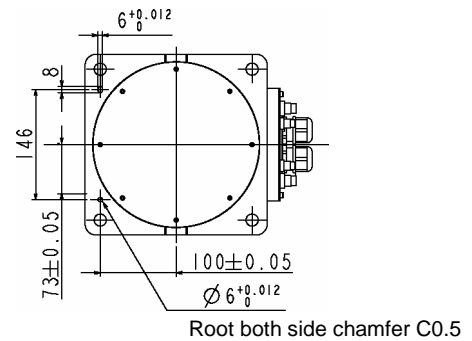
| | G10/G20-**1C | G10/G20-**4C |
|---|--------------|--------------|
| b | 150 | 390 |
| c | 870.5 | 1129.5 |
| d | 205.5 | -34.5 |



(*) indicates the stroke margin by mechanical stop.



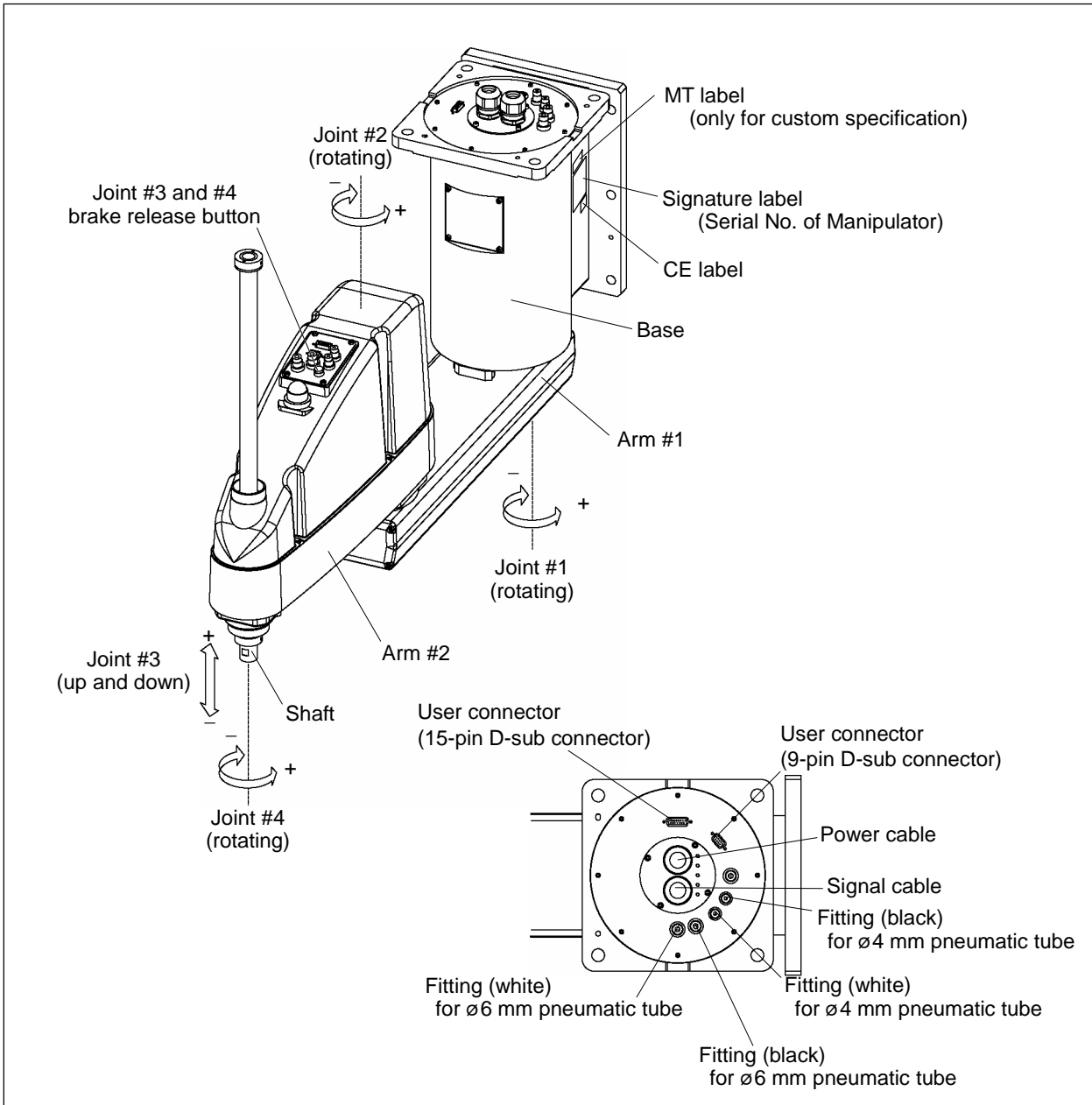
Detail of "A"
(Calibration point position of Joints #3 and #4)



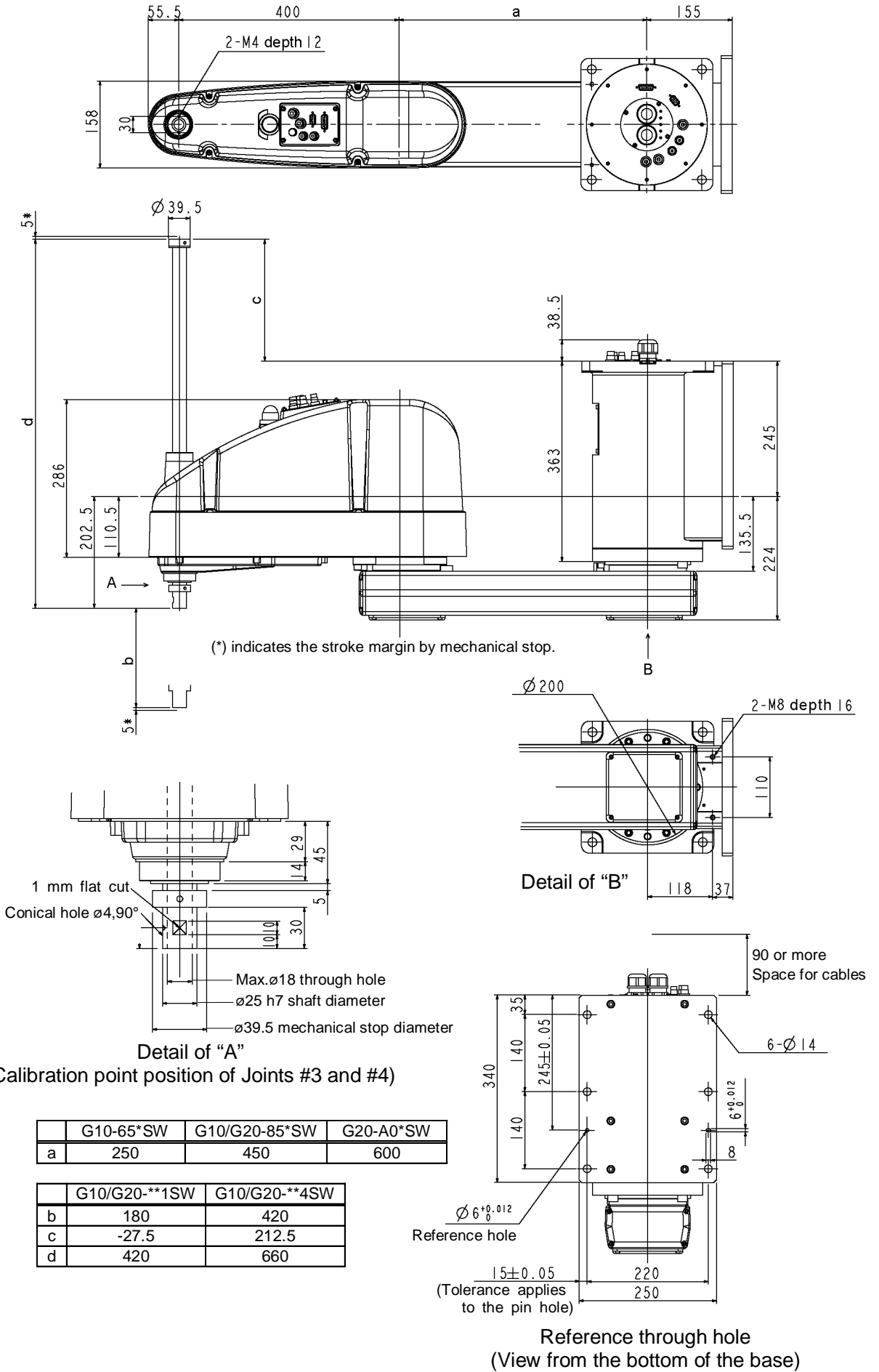
Reference through hole
(View from the bottom of the base)

2.3.2 Wall Mounting

Standard-model G10/G20-***SW



NOTE The brake release button affects both Joints #3 and #4. When the brake release button is pressed in emergency mode, the brakes for both Joints #3 and #4 are released simultaneously. (For G6-**1**, Joint #4 has no brake on it.)

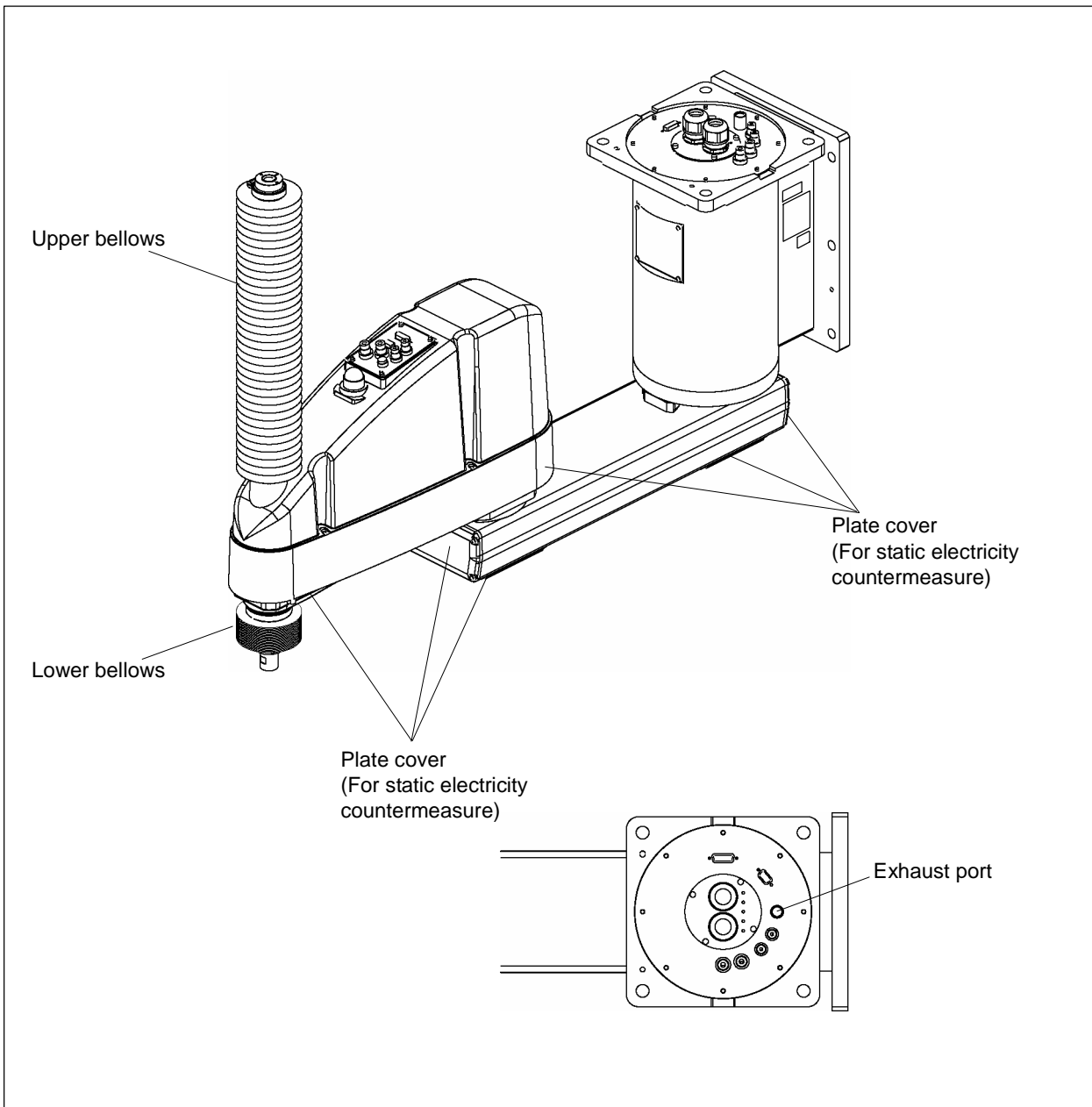


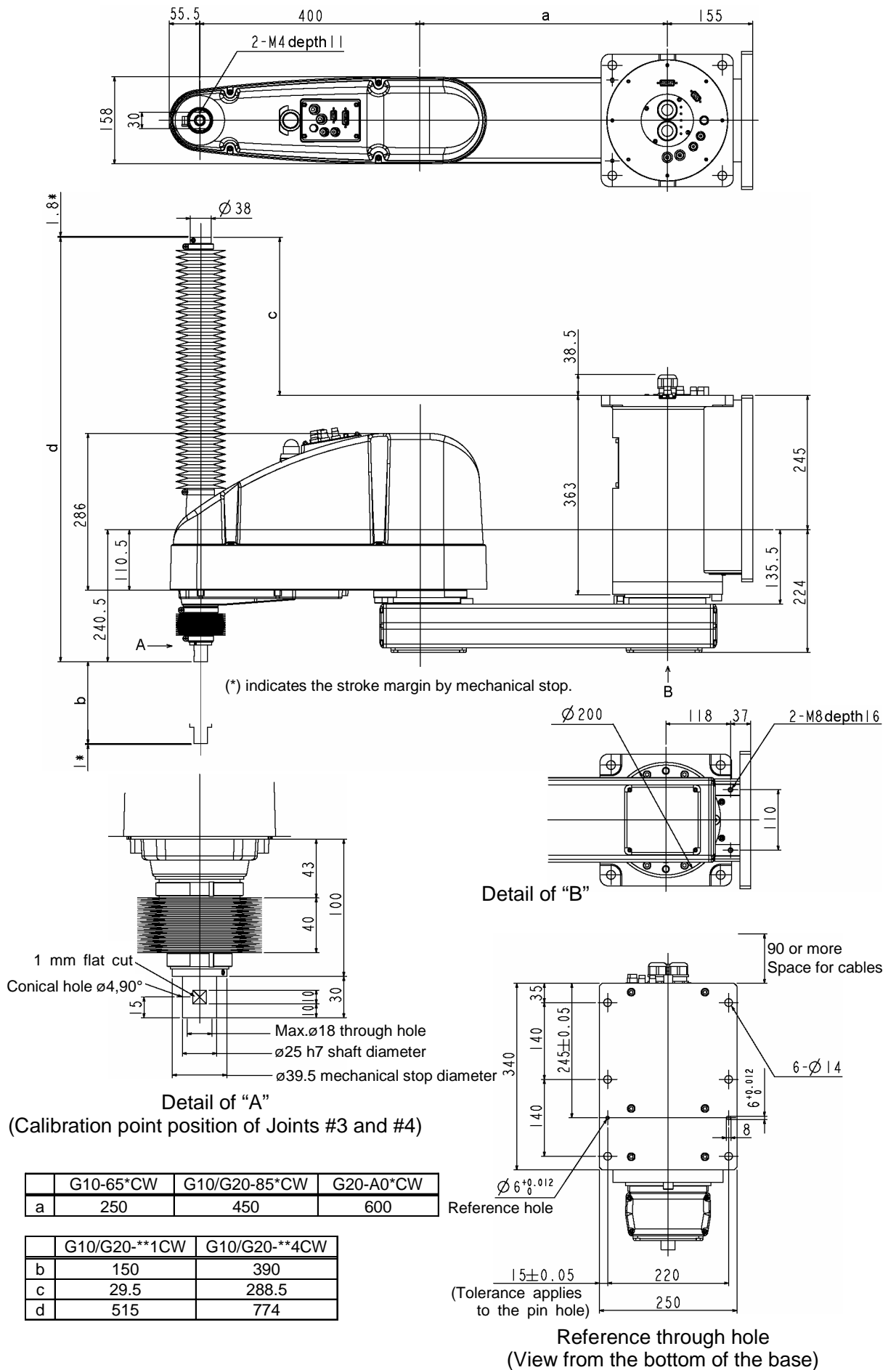
| | G10-65*SW | G10/G20-85*SW | G20-A0*SW |
|---|-----------|---------------|-----------|
| a | 250 | 450 | 600 |

| | G10/G20-**1SW | G10/G20-**4SW |
|---|---------------|---------------|
| b | 180 | 420 |
| c | -27.5 | 212.5 |
| d | 420 | 660 |

Cleanroom-model G10/G20-***CW

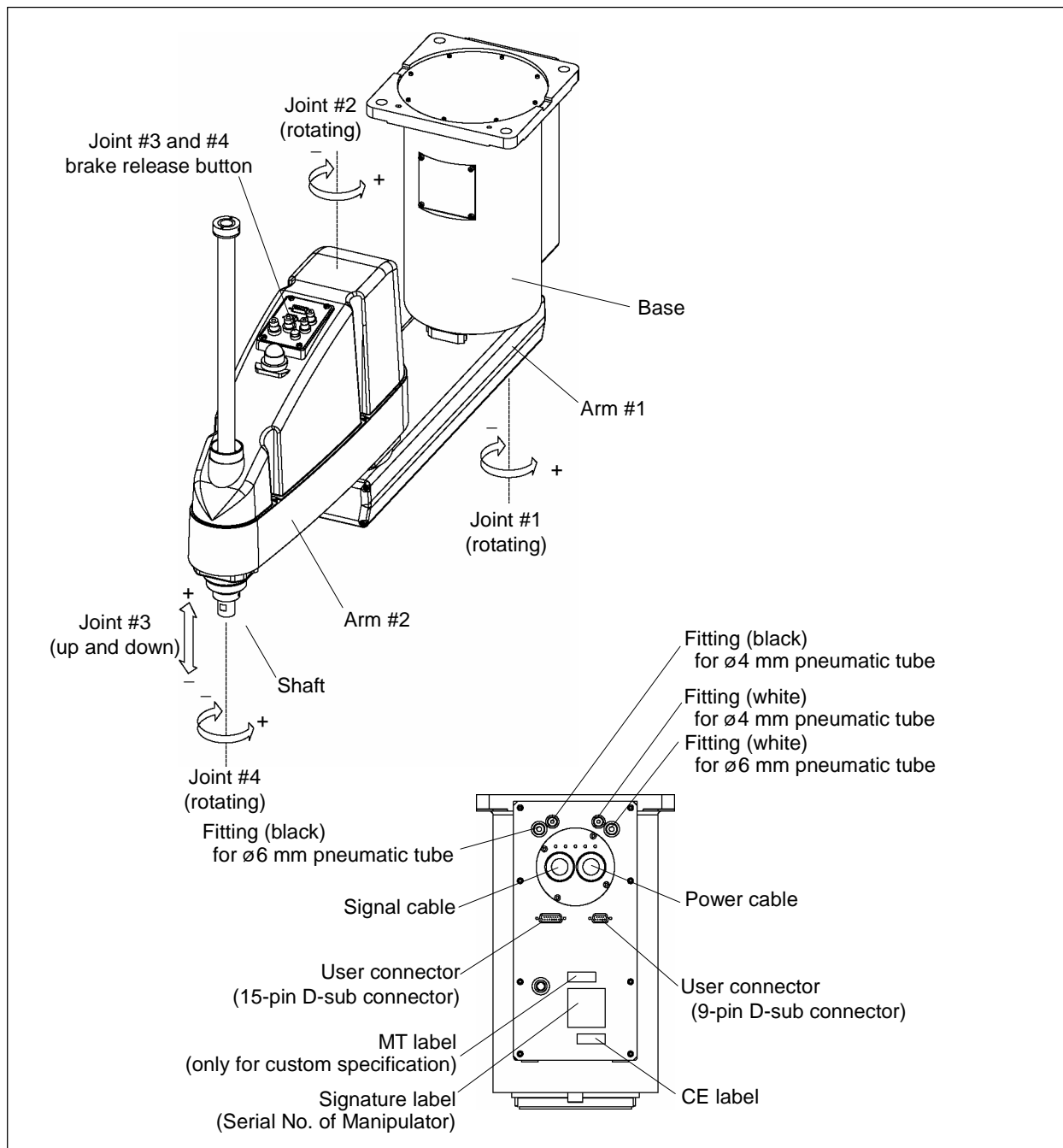
The following figure shows the additional parts and specifications for the Wall mounting Cleanroom-model when compared with the Standard-model in appearance.




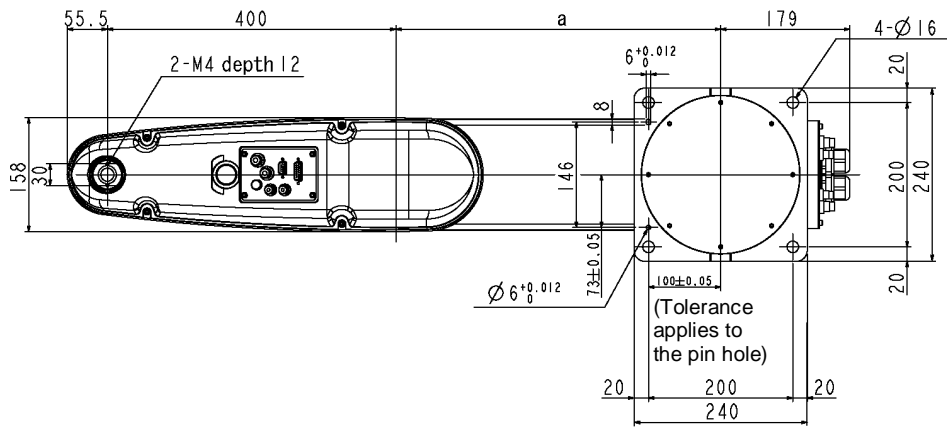


2.3.3 Ceiling Mounting

Standard-model G10/G20-***SR

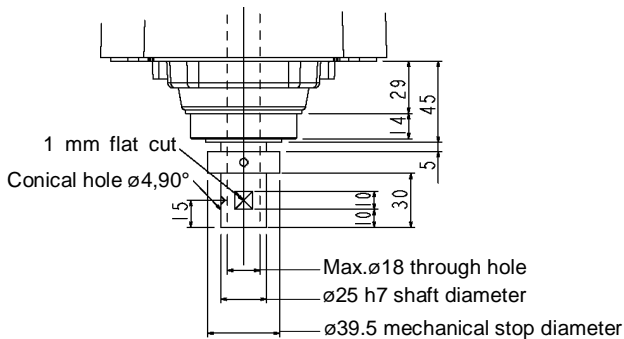
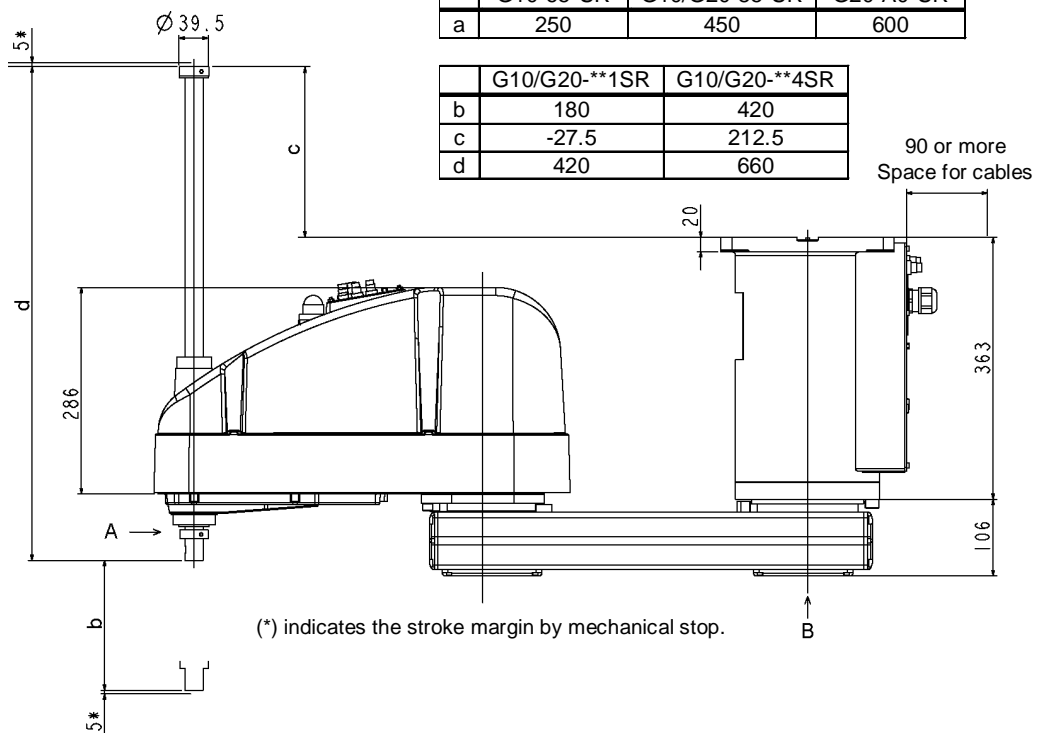


NOTE  The brake release button affects both Joints #3 and #4. When the brake release button is pressed in emergency mode, the brakes for both Joints #3 and #4 are released simultaneously. (For G6-***1**, Joint #4 has no brake on it.)

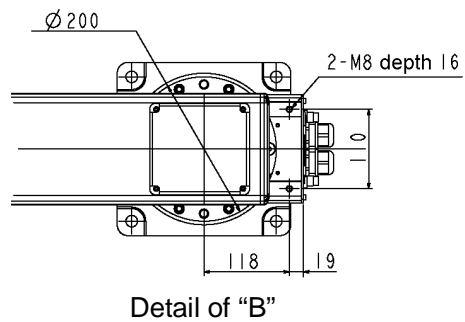


| | G10-65*SR | G10/G20-85*SR | G20-A0*SR |
|---|-----------|---------------|-----------|
| a | 250 | 450 | 600 |

| | G10/G20-**1SR | G10/G20-**4SR |
|---|---------------|---------------|
| b | 180 | 420 |
| c | -27.5 | 212.5 |
| d | 420 | 660 |



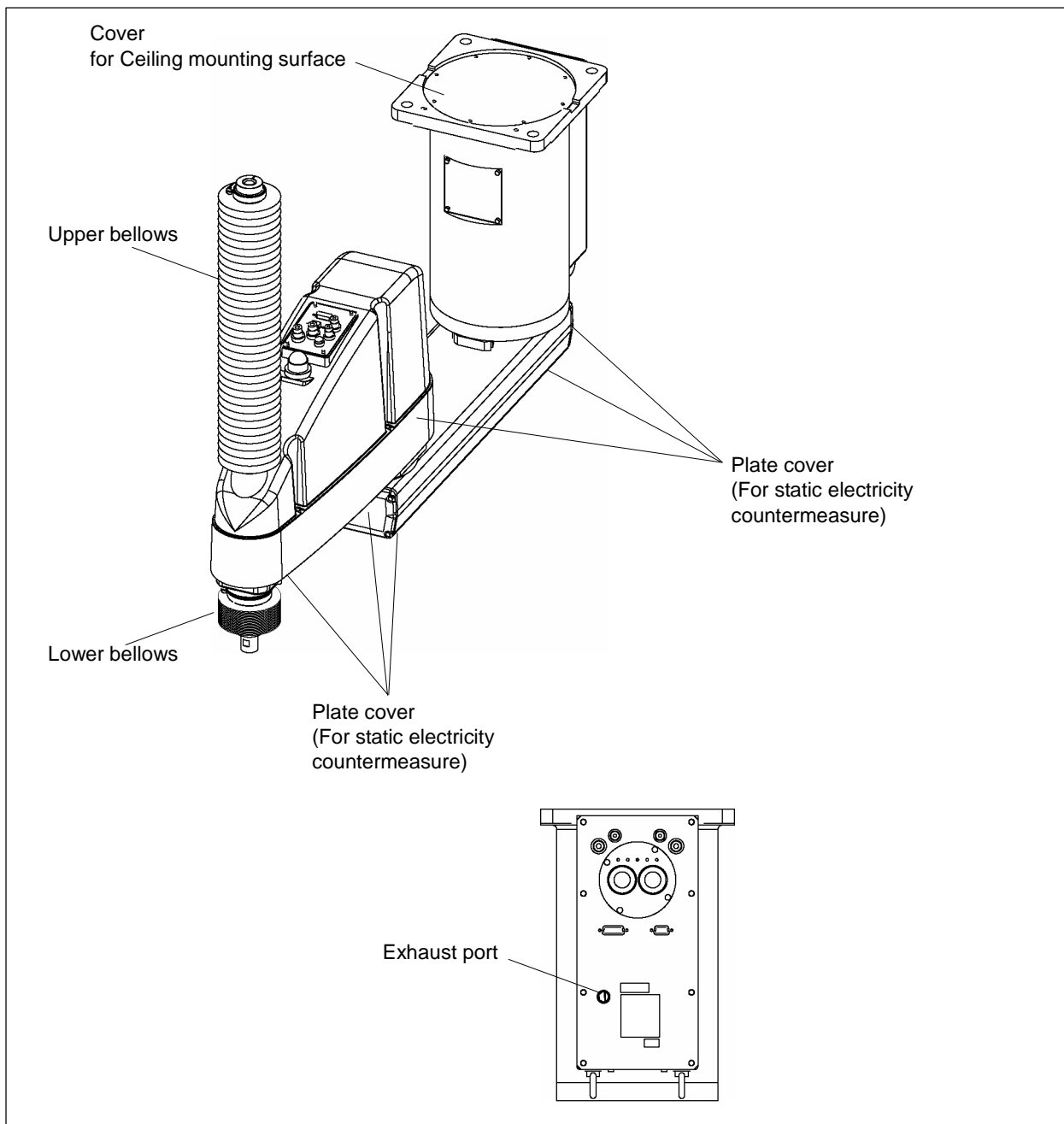
Detail of "A"
(Calibration point position of Joints #3 and #4)

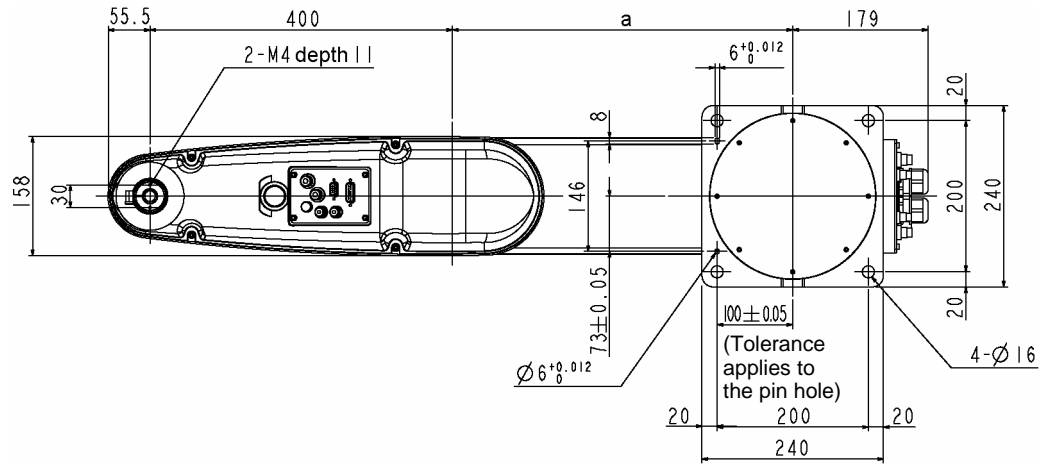


Detail of "B"

Cleanroom-model G10/G20-***CR

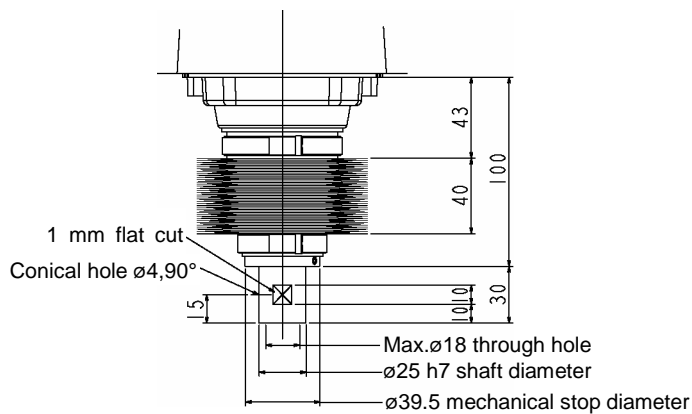
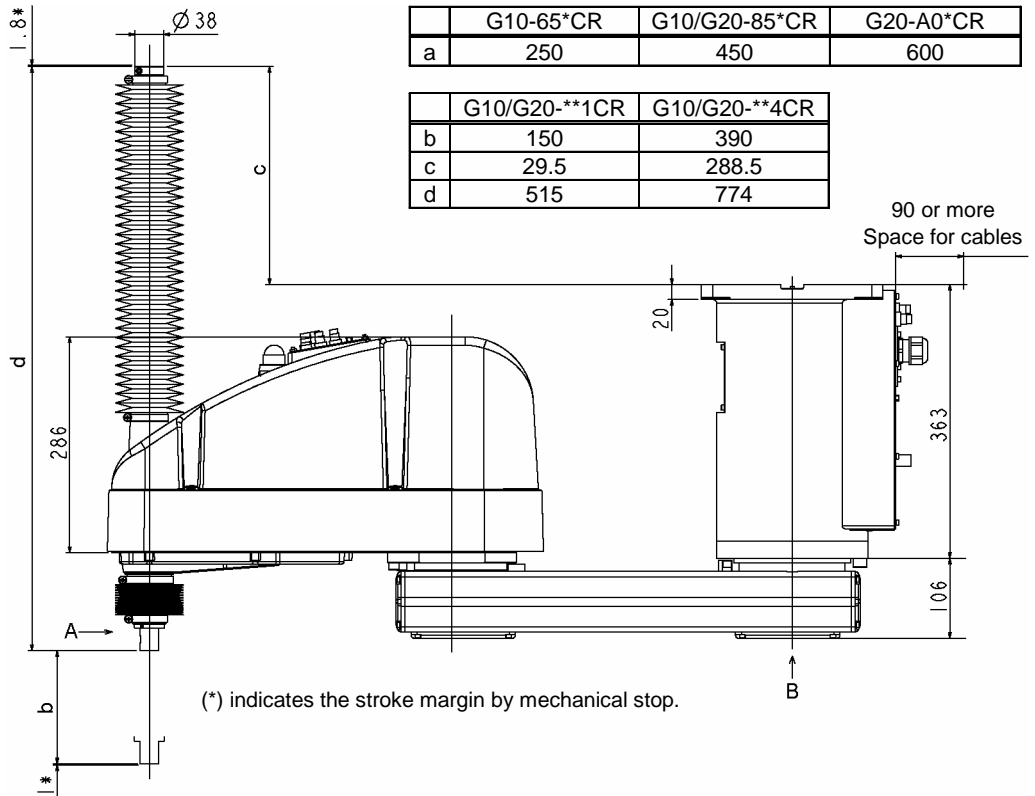
The following figure shows the additional parts and specifications for the Ceiling mounting Cleanroom-model when compared with the Standard-model in appearance.





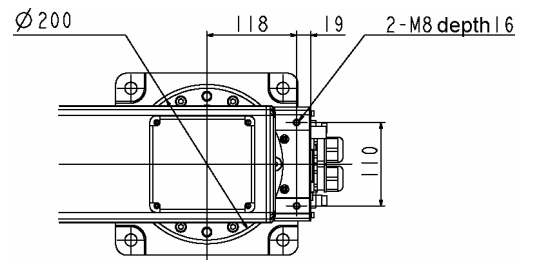
| | G10-65*CR | G10/G20-85*CR | G20-A0*CR |
|---|-----------|---------------|-----------|
| a | 250 | 450 | 600 |

| | G10/G20-**1CR | G10/G20-**4CR |
|---|---------------|---------------|
| b | 150 | 390 |
| c | 29.5 | 288.5 |
| d | 515 | 774 |



Detail of "A"

(Calibration point position of Joints #3 and #4)



Detail of "B"

2.4 Specifications

| Item | | | G10/G20-**** | G10/G20-****R | G10/G20-*****W |
|--|---------------|--|--|---------------|---------------------|
| Mount method | | | Table Top | Ceiling | Wall |
| Environment | | | Cleanroom-model *1 / Protected-model *2 | | |
| Arm length | Arm #1, #2 | 65 | 650 mm (G10 only) | | |
| | | 85 | 850 mm | | |
| | | A0 | 1000 mm (G20 only) | | |
| | Arm #3 | 1 | 180 mm : G10/G20-**1S* 150 mm : G10/G20-**1C* | | |
| | | 4 | 420 mm : G10/G20-**4S* 390 mm : G10/G20-**4C* | | |
| Weight (not include the weight of cables) | G10 | 65 | 46 kg : 102 lb | | 51 kg : 113 lb |
| | G10/G20 | 85 | 48 kg : 106 lb | | 53 kg : 117 lb |
| | G20 | A0 | 50 kg : 111 lb | | 55 kg : 122 lb |
| Driving method | All joints | | AC servo motor | | |
| Max. operating speed *3 | Joints #1, #2 | 65 | Contact us for the value. | | |
| | | 85 | 11000 mm/s | | |
| | | A0 | 11500mm/sec | | |
| | Joint #3 | 1 | 1100 mm/s | | |
| | | 4 | 2350 mm/s | | |
| | Joint #4 | G10 | 2400 deg/s | | |
| G20 | | 1600 deg/s | | | |
| Repeatability | Joints #1, #2 | | ±0.025 mm | | |
| | Joint #3 | | ±0.01 mm | | |
| | Joint #4 | | ±0.005 deg | | |
| Max. motion range | Joint #1 | 65 | ±152 deg | | ±107 deg |
| | | 85 | | | |
| | | A0 | | | |
| | Joint #2 | 65 | ±152.5 deg *a | | ±130 deg |
| | | 85 | | | |
| | | A0 | | | |
| Joint #3 | 1 | 180 mm : G10/G20-**1S* 150 mm : G10/G20-**1C* | | | |
| | 4 | 420 mm : G10/G20-**4S* 390 mm : G10/G20-**4C* | | | |
| Joint #4 | | | ±360 deg | | |
| Max. pulse range (pulse) | Joint #1 | 65 | -1805881 to +7048761 | | -495161 to +5738041 |
| | | 85 | | | |
| | | A0 | | | |
| | Joint #2 | 65 | ±2776178 *a | | ±2366578 |
| | | 85 | | | |
| | | A0 | | | |
| | Joint #3 | 1 | -1946420 : G10/G20-**1S* -1622016 : G10/G20-**1C* | | |
| | | 4 | -2270823 : G10/G20-**4S* -2108621 : G10/G20-**4C* | | |
| | Joint #4 | G10 | ±1951517 | | |
| G20 | | ±2752512 | | | |

*a : The Joint #2 values for the following manipulators

| | Max. motion range | Max. pulse range |
|--|-------------------|------------------|
| G10/G20-85C (Z: -360 to -390 only) G10/G20-85CW G10/G20-85CR | ±151 deg | ±2748871 |

| Item | | G10-**** | G20-**** | |
|--|---------------------------|---|------------------------|--|
| Resolution | Joint #1 | 0.0000343 deg/pulse | | |
| | Joint #2 | 0.0000549 deg/pulse | | |
| | Joint #3 | 1 | 0.0000925 mm/pulse | |
| | | 4 | 0.000185 mm/pulse | |
| Joint #4 | 0.0001845 deg/pulse | 0.0001308 deg/pulse | | |
| Motor power consumption | Joint #1 | 750 W | | |
| | Joint #2 | 600 W | | |
| | Joint #3 | 400 W | | |
| | Joint #4 | 150 W | | |
| Payload | rated | 5 kg | 10 kg | |
| | max. | 10 kg | 20 kg | |
| Joint #4 allowable moment of inertia *4 | rated | 0.02 kg·m ² | 0.05 kg·m ² | |
| | max. | 0.25 kg·m ² | 0.45 kg·m ² | |
| Hand | Shaft diameter | ø25 mm | | |
| | Through hole | ø18 mm | | |
| Joint #3 down force | | 250 N | 150 N | |
| Installed wire for customer use | | 24 (15 pin + 9 pin : D-sub) | | |
| Installed pneumatic tube for customer use | | 2 pneumatic tubes (ø6 mm) : 0.59 Mpa (6 kgf/cm ² : 86 psi) | | |
| | | 2 pneumatic tubes (ø4 mm) : 0.59 Mpa (6 kgf/cm ² : 86 psi) | | |
| Environmental requirements | Ambient Temperature | 5 to 40°C (with minimum temperature variation) | | |
| | Ambient relative humidity | 10 to 80% (no condensation) | | |
| Equivalent continuous A-weighted sound pressure level *5 | | L _{Aeq} = 70 dB(A) | | |
| Applicable Controller | | RC180 | | |
| Assignable Value () Default values | Speed | 1 to (5) to 100 | | |
| | Accel *6 | 1 to (10) to 120 | | |
| | SpeedS | 1 to (50) to 2000 | | |
| | AccelS | 1 to (200) to 25000 | | |
| | Fine | 0 to (10000) to 65000 | | |
| | Weight | 0,400 to (5,400) to 10,400 | | |
| MTBF | | 3 years | | |
| Safety standard | | ANSI/RIA R15.06 compliant CE compliant | | |

*1: The exhaust system in the Cleanroom-model Manipulator (G10/G20-***C*) draws air from the base interior and arm cover interior.

A crack or other opening in the base unit can cause loss of negative air pressure in the outer part of the arm, which can cause increased dust emission.

Do not remove the maintenance cover on the front of the base.

Seal the exhaust port and the exhaust tube with vinyl tape so that the joint is airtight.

If the exhaust flow is not sufficient, dust particle emission may exceed the specified maximum level.

Cleanliness level: Class ISO 3 (ISO14644-1)

In previous criteria; Clean Class: 10 or its equivalent


Amount of Dust (0.1 μm diameter or larger) in 28317 cm³ (1cft) sample-air around the center of the motion rang: 10 particles or less.)

Exhaust System : Exhaust port diameter : Inner diameter: $\phi 12$ mm / Outer diameter: $\phi 16$ mm
 Exhaust tube : Polyurethane tube
 Outer diameter: $\phi 12$ mm (Inner diameter: $\phi 8$ mm)
 or Inner diameter $\phi 16$ mm or larger
 Recommended exhaust flow rate : Approx. $1000 \text{ cm}^3/\text{s}$ (Normal)

- *2: Contact us for detail information regarding the Protected-model Manipulator.
- *3: In the case of PTP command. Maximum operating speed for CP command is 2000 mm/s on horizontal plane.
- *4: In the case where the center of gravity is at the center of Joint #4. If the center of gravity is not at the center of Joint #4, set the parameter using Inertia command.
- *5: Conditions of Manipulator during measurement as follows:
 - Operating conditions : Under rated load, 4-joints simultaneous motion, maximum speed, maximum acceleration, and duty 50%.
 - Measurement point : In front of the Manipulator, 1000 mm apart from the motion range, 50 mm above the base-installed surface.
- *6: In general use, Accel setting 100 is the optimum setting that maintains the balance of acceleration and vibration when positioning.
 However, you may require an operation with high acceleration to shorten the cycle time by decreasing the vibration at positioning. In this case, set Accel to larger than 100.
 If you specify a larger Accel value, the frequency of the overload error and over heat may rise during continuous operation. The use of large Accel setting is recommended only for necessary motions.

2.5 How to Set the Model

The Manipulator model for your system has been set before shipment from the factory. It is normally not required to change the model when you receive your system.

| | |
|--|--|
|  CAUTION | <ul style="list-style-type: none"> ■ When you need to change the setting of the Manipulator model, be sure to set the Manipulator model properly. Improper setting of the Manipulator model may result in abnormal or no operation of the Manipulator and/or cause safety problems. |
|--|--|



If an MT label is attached to the rear of a Manipulator, the Manipulator has custom specifications. The custom specifications may require a different configuration procedure; check the custom specifications number described on the MT label and contact us when necessary.

The Manipulator model can be set from software.
 Refer to the chapter *Robot Configuration* in the *EPSON RC+ User's Guide*.

3. Environments and Installation

3.1 Environmental Conditions

A suitable environment is necessary for the robot system to function properly and safely. Be sure to install the robot system in an environment that meets the following conditions:

| Item | Conditions |
|-----------------------------------|--|
| Ambient temperature ^{*1} | 5 to 40°C (with minimum temperature variation) |
| Ambient relative humidity | 10 to 80% (no condensation) |
| First transient burst noise | 2 kV or less |
| Electrostatic noise | 6 kV or less |
| Environment | <ul style="list-style-type: none"> · Install indoors. · Keep away from direct sunlight. · Keep away from dust, oily smoke, salinity, metal powder or other contaminants. · Keep away from flammable or corrosive solvents and gases. · Keep away from water. · Keep away from shocks or vibrations. · Keep away from sources of electric noise. |



Manipulators are not suitable for operation in harsh environments such as painting areas, etc. When using Manipulators in inadequate environments that do not meet the above conditions, please contact us.

*1 The ambient temperature conditions are for the Manipulators only. For the Controller the Manipulators are connected to, refer to the Controller manual.

3.2 Base Table

A base table for anchoring the Manipulator is not supplied. Please make or obtain the base table for your Manipulator. The shape and size of the base table differs depending on the use of the robot system. For your reference, we list some Manipulator table requirements here.

The base table must not only be able to bear the weight of the Manipulator but also be able to withstand the dynamic movement of the Manipulator when the Manipulator operates at maximum acceleration. Ensure that there is enough strength on the base table by attaching reinforcing materials such as crossbeams.

The torque and reaction force produced by the movement of the Manipulator are as follows:

| | G10 | G20 |
|--|---------|---------|
| Max. Reaction torque on the horizontal plate | 1000 Nm | 1000 Nm |
| Max. Horizontal reaction force | 4500 N | 7500 N |
| Max. Vertical reaction force | 2000 N | 2000 N |

The threaded holes required for mounting the Manipulator base are M12. Use mounting bolts with specifications conforming to ISO898-1 property class: 10.9 or 12.9. For dimensions, refer to *Setup & Operation: 3.3 Mounting Dimensions*.

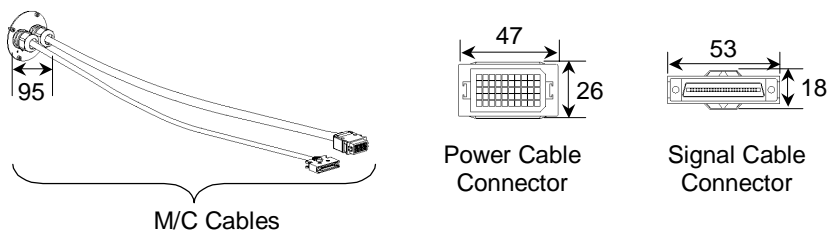
The plate for the Manipulator mounting face should be 20 mm thick or more and made of steel to reduce vibration. The surface roughness of the steel plate should be 25 µm or less.

The table must be secured on the floor or wall to prevent it from moving.

The Manipulator must be installed horizontally.

When using a leveler to adjust the height of the base table, use a screw with M16 diameter or more.

If you are passing cables through the holes on the base table, see the figures below.
[unit : mm]



Do not remove the M/C cables from the Manipulator.



For environmental conditions regarding space when placing the Controller on the base table, refer to the *Controller manual*.

| | |
|--------------------|---|
| WARNING | <ul style="list-style-type: none"> To ensure safety, a safeguard must be installed for the robot system. For details on the safeguard, refer to the <i>EPSON RC+ User's Guide</i>. |
|--------------------|---|

3.3 Mounting Dimensions

The maximum space described in figures shows that the radius of the end effector is 60 mm or less. If the radius of the end effector exceeds 60 mm, define the radius as the distance to the outer edge of maximum space.

If a camera or electromagnetic valve extends outside of the arm, set the maximum range including the space that they may reach.

Be sure to allow for the following extra spaces in addition to the space required for mounting the Manipulator, Controller, and peripheral equipment.

space for teaching

space for maintenance and inspection

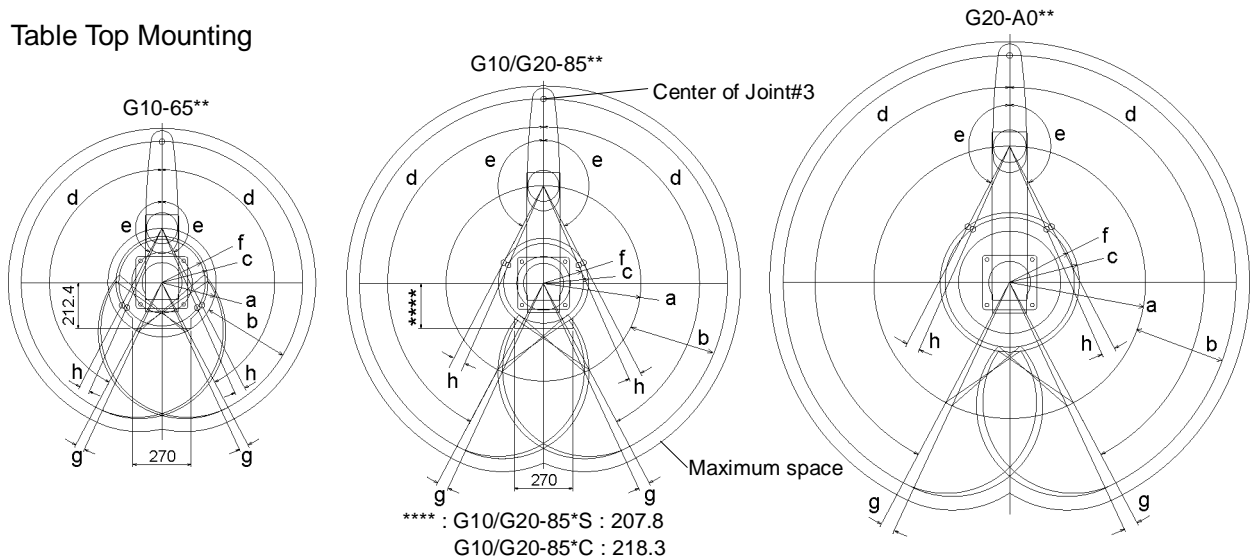
(Ensure a space to open the rear side cover and the maintenance cover for maintenance.)

space for cables

The minimum bend radius of the power cable is 90 mm. When installing the cable, be sure to maintain sufficient distance from obstacles. In addition, leave enough space for other cables so that they are not bent forcibly.

Ensure distance to the safeguard from the maximum motion range is more than 100 mm.

Table Top Mounting

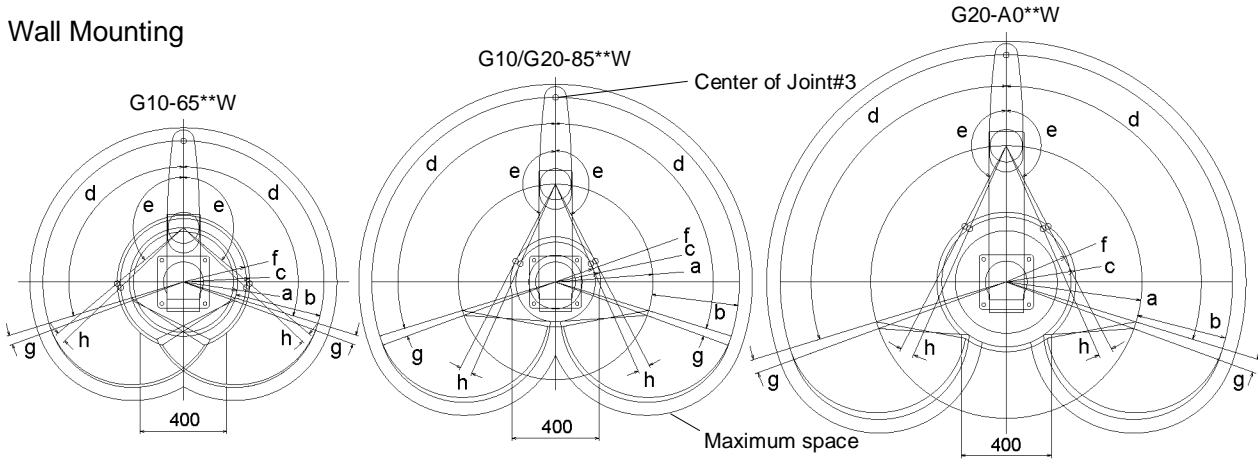


| | G10-65** | G10/G20-85* | | G20-A0** | |
|--|----------|-------------|---------------------------------|----------------|-------|
| | | S | C | | |
| a Length of Arm #1 (mm) | 250 | 450 | | 600 | |
| b Length of Arm #2 (mm) | 400 | 400 | | 400 | |
| c (Motion range) | 212.4 | 207.8 | Z: 0 to -360 Z: -360 ~ -390 | 207.8 218.3 | 307 |
| d Motion range of Joint #1 (degree) | 152 | 152 | | 152 | |
| e Motion range of Joint #2 (degree) | 152.5 | 152.5 | Z: 0 to -360 Z: -360 to -390 | 152.5 151 | 152.5 |
| f (Mechanical stop area) | 199.4 | 183.3 | | 285.4 | |
| g Joint #1 angle to hit mechanical stop (degree) | 3 | 3 | | 3 | |
| h Joint #2 angle to hit mechanical stop (degree) | 3.5 | 3.5 | Z: 0 to -360 Z: -360 to -390 | 3.5 5 | 3.5 |

NOTE

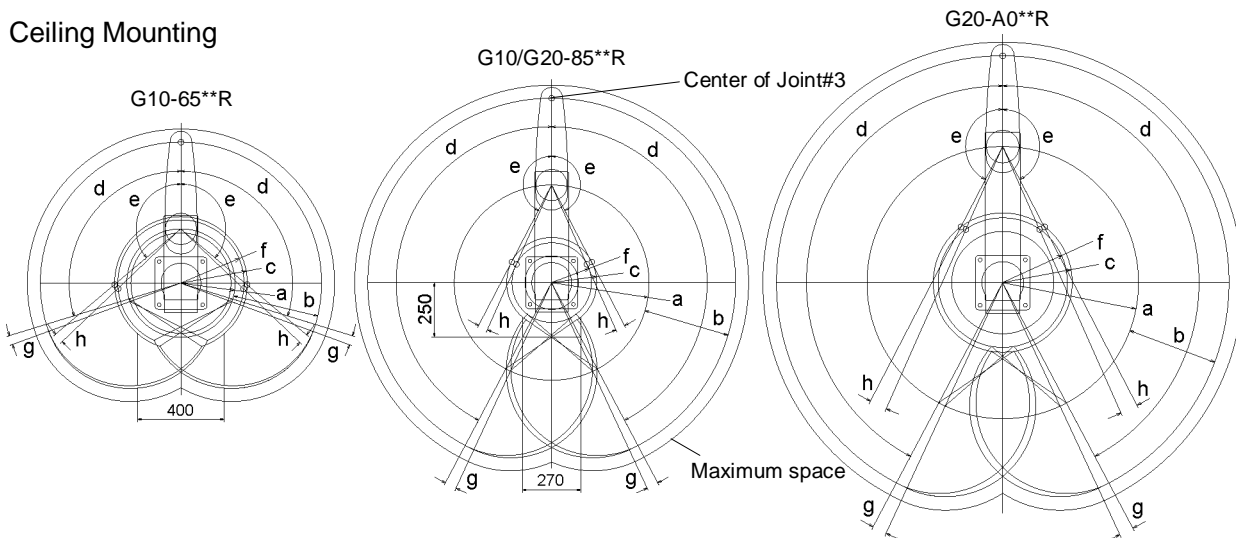
In the range Z: -360 to -390 mm, the area is limited by interference of the Manipulator body and the arm.

Wall Mounting



| | G10-65**W | G10/G20-85* | | G20-A0**W |
|--|-----------|-------------|-------|-----------|
| | | SW | CW | |
| a Length of Arm #1 (mm) | 250 | 450 | | 600 |
| b Length of Arm #2 (mm) | 400 | 400 | | 400 |
| c (Motion range) | 306.5 | 207.8 | 218.3 | 307 |
| d Motion range of Joint #1 (degree) | 107 | 107 | | 107 |
| e Motion range of Joint #2 (degree) | 130 | 152.5 | 151 | 152.5 |
| f (Mechanical stop area) | 291.2 | 183.3 | | 285.4 |
| g Joint #1 angle to hit mechanical stop (degree) | 3 | 3 | | 3 |
| h Joint #2 angle to hit mechanical stop (degree) | 3.5 | 3.5 | 5 | 3.5 |

Ceiling Mounting





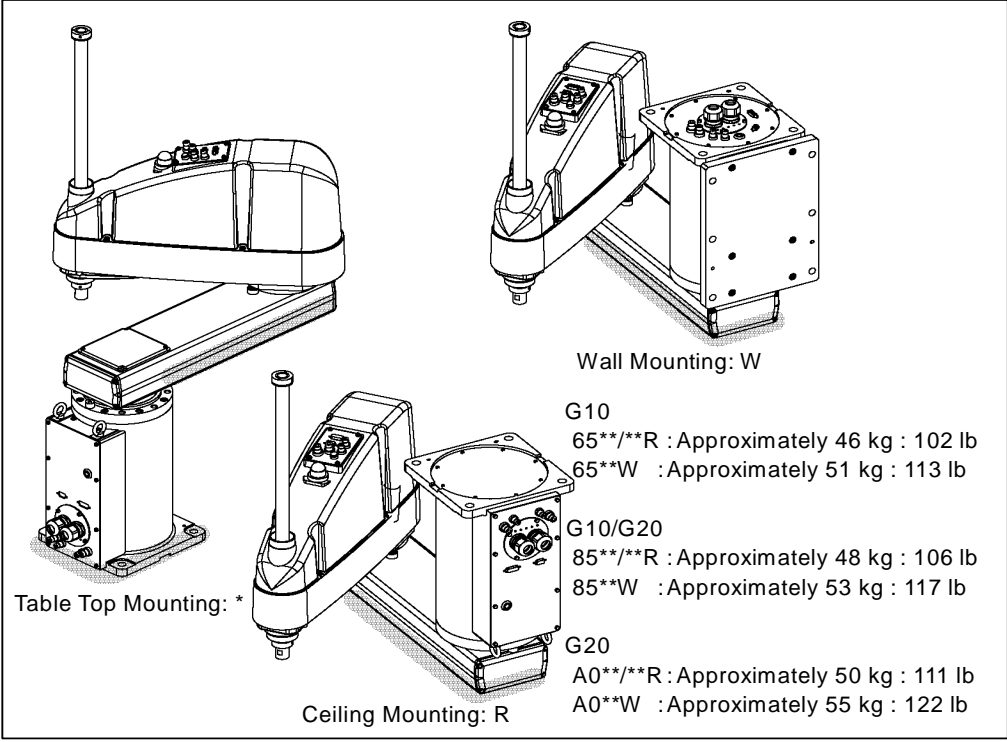
| | G10-65**R | G10/G20-85* | | G20-A0**R |
|--|-----------|-------------|-------|-----------|
| | | SR | CR | |
| a Length of Arm #1 (mm) | 250 | 450 | | 600 |
| b Length of Arm #2 (mm) | 400 | 400 | | 400 |
| c (Motion range) | 306.5 | 207.8 | 218.3 | 307 |
| d Motion range of Joint #1 (degree) | 107 | 152 | | 152 |
| e Motion range of Joint #2 (degree) | 130 | 152.5 | 151 | 152.5 |
| f (Mechanical stop area) | 291.2 | 183.3 | | 285.4 |
| g Joint #1 angle to hit mechanical stop (degree) | 3 | 3 | | 3 |
| h Joint #2 angle to hit mechanical stop (degree) | 3.5 | 3.5 | 5 | 3.5 |

3.4 Unpacking and Transportation

3.4.1 Precautions for Transportation

THE INSTALLATION SHALL BE PREFORMED BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES.

| | |
|---|--|
|  WARNING | <ul style="list-style-type: none"> Only authorized personnel should perform sling work and operate a crane and a forklift. When these operations are performed by unauthorized personnel, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system. |
|---|--|

| | |
|---|---|
|  CAUTION | <ul style="list-style-type: none"> Using a cart or similar equipment, transport the Manipulator in the same manner as it was delivered. After removing the bolts securing the Manipulator to the delivery equipment, the Manipulator can fall. Be careful not to get hands or fingers caught. The arm is secured with a wire tie. Leave the wire tie secured until you finish the installation so as not to get hands or fingers caught. To carry the Manipulator, secure the Manipulator to the delivery equipment, or pass belts through the eyebolts and hoist it with your hands. Make sure to hold the areas indicated in gray in the figure (bottom of Arm #1 and bottom of the base) by hand. <div style="text-align: right; margin-top: 10px;">  <p> Wall Mounting: W G10 65**/**R : Approximately 46 kg : 102 lb 65**W : Approximately 51 kg : 113 lb G10/G20 85**/**R : Approximately 48 kg : 106 lb 85**W : Approximately 53 kg : 117 lb G20 A0**/**R : Approximately 50 kg : 111 lb A0**W : Approximately 55 kg : 122 lb </p> </div> <ul style="list-style-type: none"> Be careful not to get hands or fingers caught when holding the bottom of the base by hand. Stabilize the Manipulator with your hands when hoisting it. When transporting the Manipulator for a long distance, secure it to the delivery equipment directly so that the Manipulator never falls. If necessary, pack the Manipulator in the same style as it was delivered. |
|---|---|

3.4.2 Transportation

Transport the Manipulator following the instructions below:

- (1) Attach the eyebolts to the upper back side of the Arm.
- (2) Pass the belts through the eyebolts.
- (3) Hoist the Manipulator slightly so that it does not fall. Then, remove the bolts securing the Manipulator to the delivery equipment or pallet.
- (4) Hoist the Manipulator holding it by hand so that it can keep its balance. Then, move it to the base table.

3.5 Installation Procedure

The following sections describe the installation of the Standard Manipulator.

3.5.1 Table Top Mounting


3.5.2 Wall Mounting

3.5.3 Ceiling Mounting

When the Manipulator is a Cleanroom-model, refer to the following section.

3.5.4 Cleanroom-model

3.5.1 Table Top Mounting

| | |
|---|---|
|  CAUTION | <p>■ Install the Table Top Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator.</p> <p>G10-65** : Approximately 46 kg :102 lb. G10/G20-85** : Approximately 48 kg :106 lb. G20-A0** : Approximately 50 kg :111 lb.</p> |
|---|---|

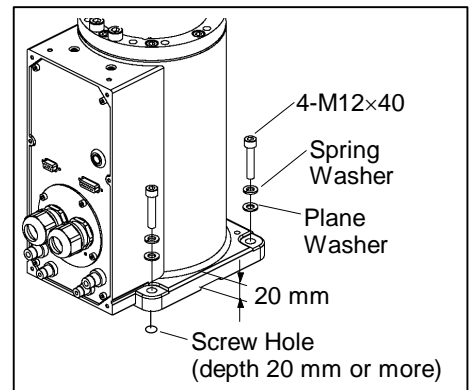
Standard Model

- (1) Secure the base to the base table with four bolts.

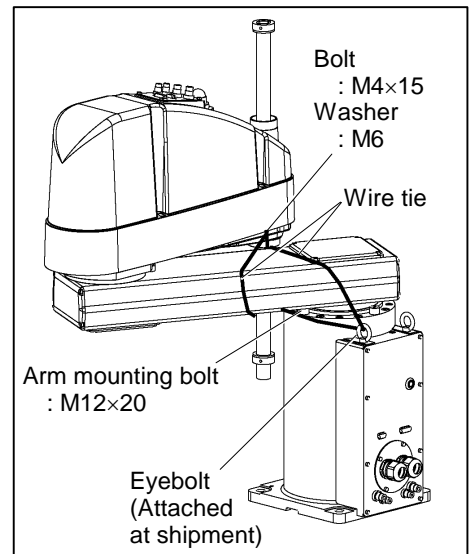


Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.


Tightening torque
 : 7350 N·cm (750 kgf·cm)



- (2) Using nippers, cut off the wire tie binding the shaft and arm retaining bracket on the base.
- (3) Remove the bolts securing the wire ties removed in step (2).

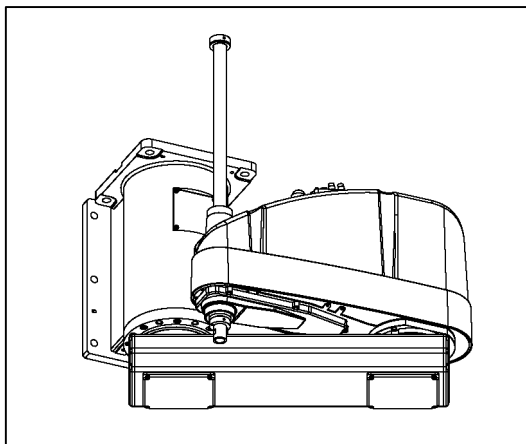


3.5.2 Wall Mounting

| | |
|---|---|
|  WARNING | <ul style="list-style-type: none"> ■ Install the Wall Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G10-65**W : Approximately 51 kg :113 lb. G10/G20-85**W : Approximately 53 kg :117 lb. G20-A0**W : Approximately 55 kg :122 lb. ■ When installing the Manipulator to the wall, support the Manipulator, and then secure the anchor bolts. Removing the support without securing the anchor bolts properly is extremely hazardous and may result in fall of the Manipulator. |
|---|---|

Standard Model

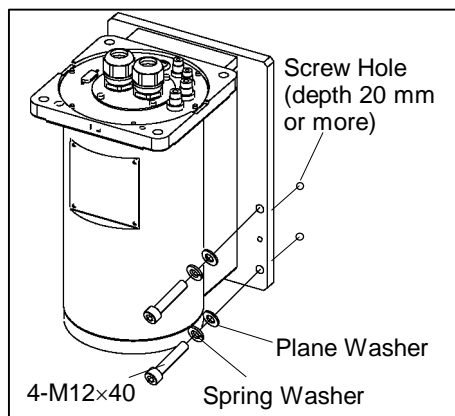
- (1) Unpack the manipulator with retaining the arm posture.




- (2) Secure the base to the wall with four bolts.

NOTE


Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.

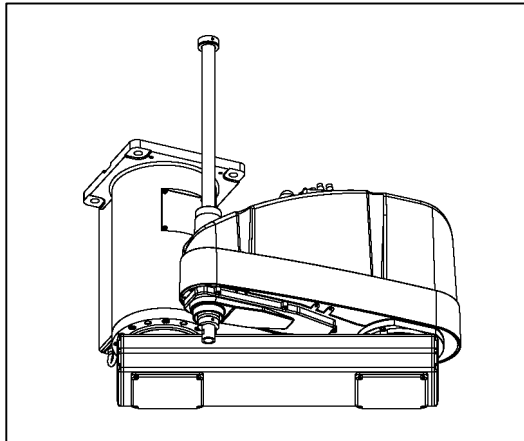


3.5.3 Ceiling Mounting

| | |
|---|---|
|  WARNING | <ul style="list-style-type: none"> ■ Install the Ceiling Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G10-65**R : Approximately 46 kg :102 lb. G10/G20-85**R : Approximately 48 kg :106 lb. G20-A0**R : Approximately 50 kg :111 lb. ■ When installing the Manipulator to the ceiling, support the Manipulator, and then secure the anchor bolts. Removing the support without securing the anchor bolts properly is extremely hazardous and may result in fall of the Manipulator. |
|---|---|

Standard Model

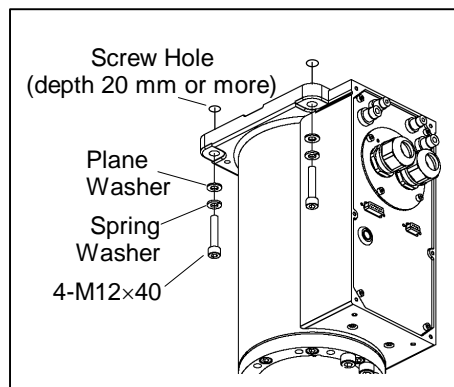
- (1) Unpack the manipulator with retaining the arm posture.



- (2) Secure the base to the ceiling with four bolts.





NOTE Use bolts with specifications conforming to ISO898-1 Property Class: 10.9 or 12.9.



3.5.4 Cleanroom-model

- (1) Unpack it outside of the clean room.
- (2) Secure the Manipulator to delivery equipment such as a pallet with bolts so that the Manipulator does not fall.
- (3) Wipe off the dust on the Manipulator with a little alcohol or distilled water on a lint-free cloth.
- (4) Carry the Manipulator in the clean room.
- (5) Refer to the installation procedure of each Manipulator model and install the Manipulator.
- (6) Connect an exhaust tube to the exhaust port.

3.6 Connecting the Cables

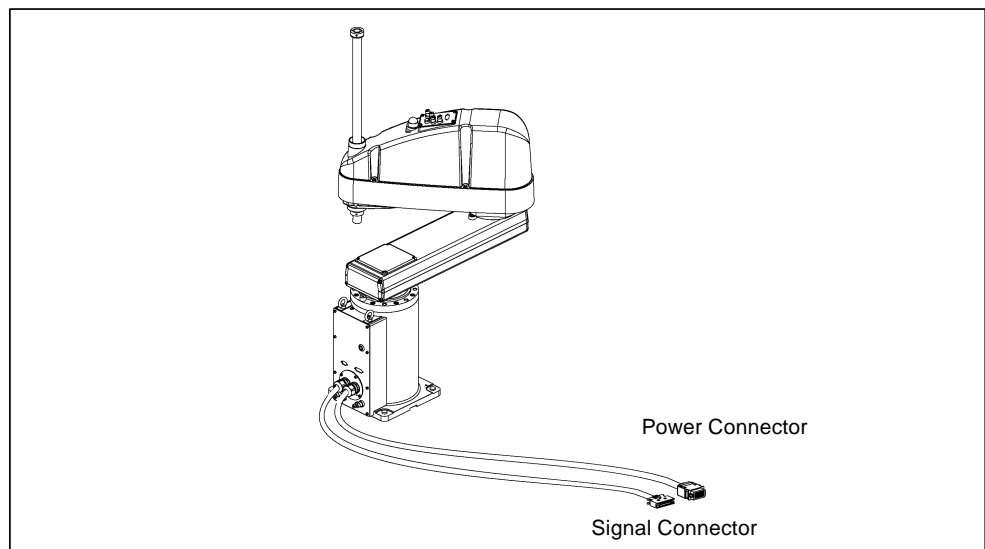
| | |
|---|---|
|  <p>WARNING</p> | <ul style="list-style-type: none"> ■ To shut off power to the robot system, pull out the power plug from the power source. Be sure to connect the AC power cable to a power receptacle. DO NOT connect it directly to a factory power source. ■ Before performing any replacement procedure, turn OFF the Controller and related equipment, and then pull out the power plug from the power source. Performing any replacement procedure with the power ON is extremely hazardous and may result in electric shock and/or malfunction of the robot system. ■ Be sure to connect the cables properly. Do not allow unnecessary strain on the cables. (Do not put heavy objects on the cables. Do not bend or pull the cables forcibly.) The unnecessary strain on the cables may result in damage to the cables, disconnection, and/or contact failure. Damaged cables, disconnection, or contact failure is extremely hazardous and may result in electric shock and/or improper function of the robot system. |
|  <p>CAUTION</p> | <ul style="list-style-type: none"> ■ When connecting the Manipulator to the Controller, make sure that the serial numbers on each equipment match. Improper connection between the Manipulator and Controller may not only cause improper function of the robot system but also serious safety problems. The connection method varies with the Controller used. For details on the connection, refer to the <i>Controller manual</i>. If the G series Manipulator or E2 series Manipulator is connected to the Controller for the PS series (ProSix), it may result in malfunction of the Manipulator. |

When the Manipulator is a Cleanroom-model, be aware of the followings.


When the Manipulator is a Cleanroom-model, use it with an exhaust system. For details, refer to *Setup & Operation: 2.4 Specifications*.

Cable Connections

Connect the power connector and signal connector of the M/C cables to the Controller.



3.7 User Wires and Pneumatic Tubes

| | |
|---|---|
|  CAUTION | <ul style="list-style-type: none"> Only authorized or certified personnel should be allowed to perform wiring. Wiring by unauthorized or uncertified personnel may result in bodily injury and/or malfunction of the robot system. |
|---|---|

User electrical wires and pneumatic tubes are contained in the cable unit.

Electrical Wires

| Rated Voltage | Allowable Current | Wires | Nominal Sectional Area | Outer Diameter | Note |
|---------------|-------------------|-------|------------------------|----------------|----------|
| AC/DC30 V | 1 A | 15 | 0.211 mm ² | ø8.3±0.3 mm | Shielded |

| | | Maker | Standard | |
|--------|--------------------|-------|-----------------|--------------------------------|
| 15 pin | Suitable Connector | JAE | DA-15PF-N | (Solder type) |
| | Clamp Hood | JAE | DA-C8-J10-F2-1R | (Connector setscrew: #4-40 NC) |
| 9 pin | Suitable Connector | JAE | DE9PF-N | (Solder type) |
| | Clamp Hood | JAE | DE-C8-J9-F2-1R | (Connector setscrew: #4-40 NC) |

Pins with the same number, indicated on the connectors on both ends of the cables, are connected.

Pneumatic Tubes

| Max. Usable Pneumatic Pressure | Pneumatic Tubes | Outer Diameter × Inner Diameter |
|---|-----------------|---------------------------------|
| 0.59 MPa (6 kgf/cm ² : 86 psi) | 2 | ø6 mm × ø4 mm |
| | 2 | ø4 mm × ø2.5 mm |

Fittings for ø6 mm and ø4 mm (outer diameter) pneumatic tubes are supplied on both ends of the pneumatic tubes.

Common Parts

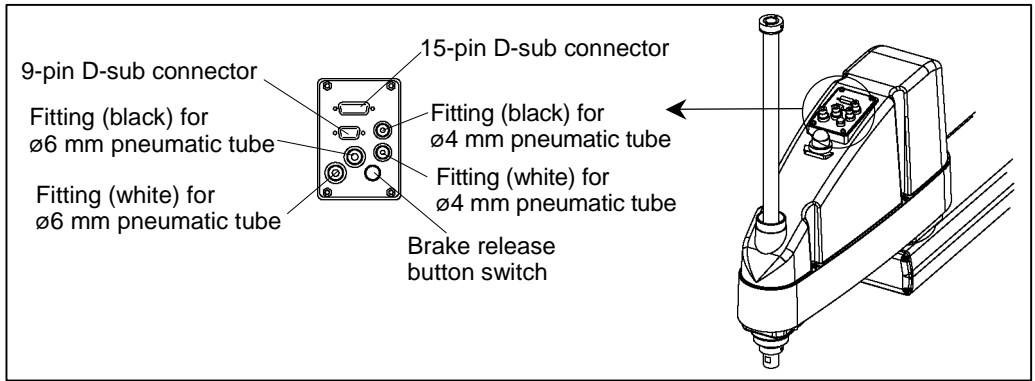
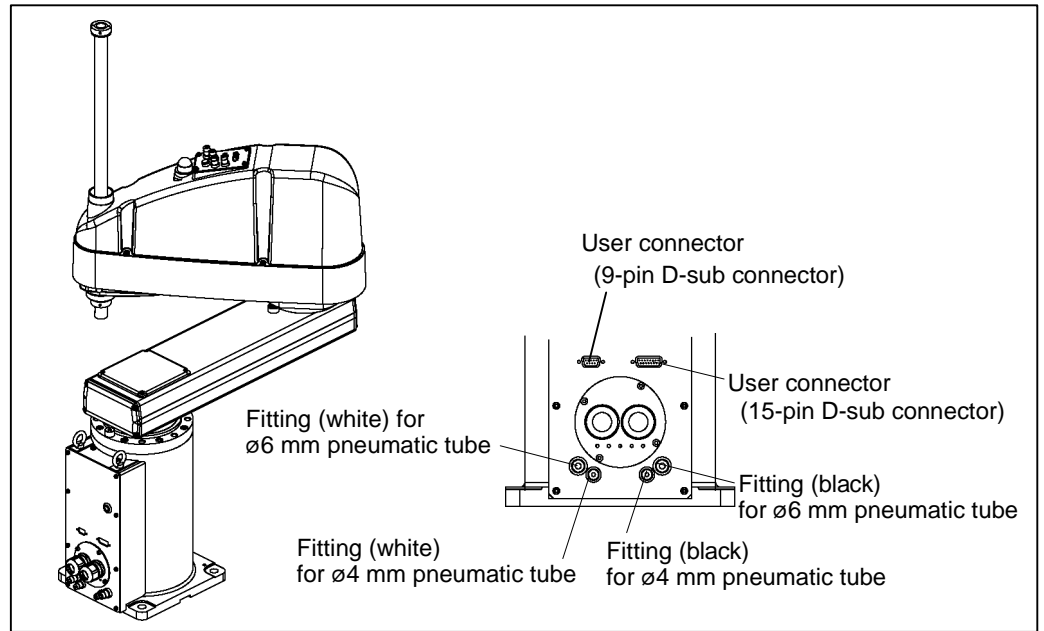
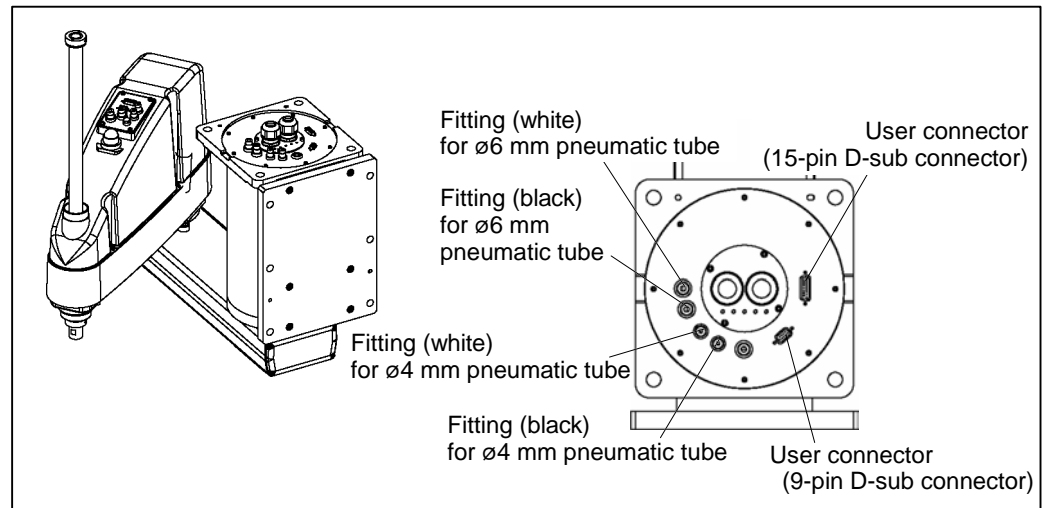


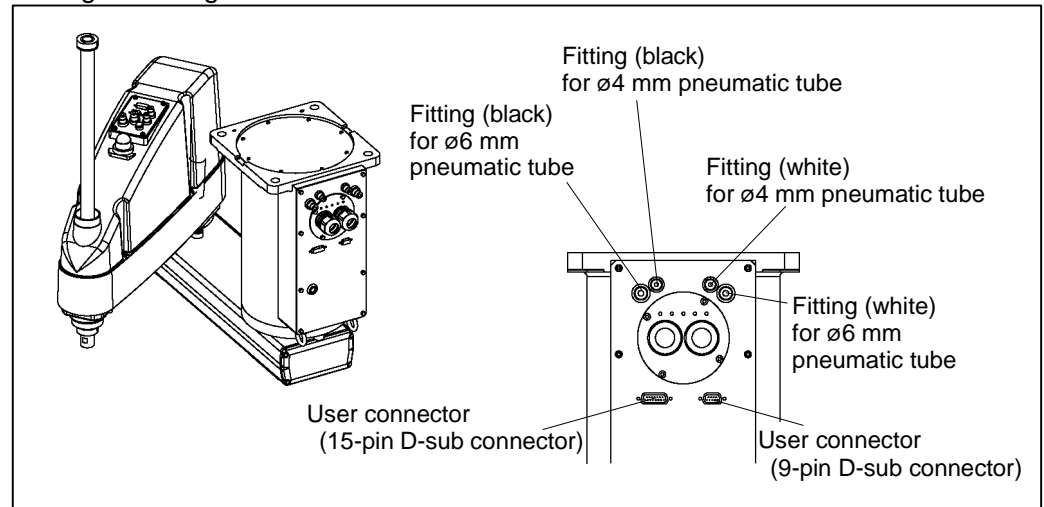
Table Top Mounting



Wall Mounting



Ceiling Mounting





3.8 Relocation and Storage

3.8.1 Precautions for Relocation and Storage

Observe the following when relocating, storing, and transporting the Manipulators.

THE INSTALLATION SHALL BE PREFORMED BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES.

| | |
|--|--|
|  WARNING | <ul style="list-style-type: none"> ■ Only authorized personnel should perform sling work and operate a crane and a forklift. When these operations are performed by unauthorized personnel, it is extremely hazardous and may result in serious bodily injury and/or severe equipment damage to the robot system. |
|--|--|

| | |
|--|--|
|  CAUTION | <ul style="list-style-type: none"> ■ Before relocating the Manipulator, fold the arm and secure it tightly with a wire tie to prevent hands or fingers from being caught in the Manipulator. ■ When removing the anchor bolts, support the Manipulator to prevent falling. Removing the anchor bolts without support may result in a fall of the Manipulator, and then get hands, fingers, or feet caught. ■ To carry the Manipulator, have four or more people to work on it and secure the Manipulator to the delivery equipment or hold the bottom of Arm #1 and the bottom of the base by hand. When holding the bottom of the base by hand, be very careful not to get hands or fingers caught. ■ Stabilize the Manipulator with your hands when hoisting it. Unstable hoisting is extremely hazardous and may result in fall of the Manipulator. |
|--|--|

When transporting the Manipulator for a long distance, secure it to the delivery equipment so that the Manipulator cannot fall.
 If necessary, pack the Manipulator in the same way as it was delivered.


When the Manipulator is used for a robot system again after long-term storage, perform a test run to verify that it works properly, and then operate it thoroughly.


Transport and store the Manipulator in the range of -25°C to +55°C.
 Humidity within 10% to 90% is recommended.

When condensation occurs on the Manipulator during transport or storage, turn ON the power only after the condensation dries.

Do not shock or shake the Manipulator during transport.

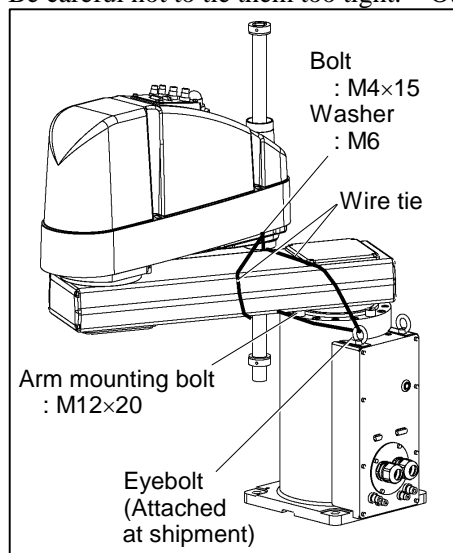
3.8.2 Table Top Mounting

| | |
|---|--|
|  CAUTION | <ul style="list-style-type: none"> ■ Install or relocate the Table Top Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. G10-65** : Approximately 46 kg :102 lb. G10/G20-85** : Approximately 48 kg :106 lb. G20-A0** : Approximately 50 kg :111 lb. |
|---|--|

NOTE  (1) Turn OFF the power on all devices and unplug the cables. Remove the mechanical stops if using them to limit the motion range of Joints #1 and #2. For details on the motion range, refer to *Setup & Operation: 5.2 Motion Range Setting by Mechanical Stops*.

(2) Attach the eyebolts on the upper back side of Arm #1.


(3) Tie the lower end of the shaft and arm, and the base and arm together with a wire tie. Be careful not to tie them too tight. Otherwise, the shaft may bend.




(4) Pass the belts through the eyebolts.

(5) Hoist the Manipulator slightly so that it does not fall. Remove four bolts securing the Manipulator.

(6) Hoist the Manipulator holding it by hand so that it can keep its balance. Then, move the Manipulator to the delivery equipment or another location and anchor it.

NOTE  Stretch the belts tight until you finish anchoring the Manipulator.

3.8.3 Wall Mounting

| | |
|--|--|
|  WARNING | <ul style="list-style-type: none"> ■ Install or relocate the Wall Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. <ul style="list-style-type: none"> G10-65**W : Approximately 51 kg :113 lb. G10/G20-85**W : Approximately 53 kg :117 lb. G20-A0**W : Approximately 55 kg :122 lb. ■ When removing the Manipulator from the wall, support the Manipulator, and then remove the anchor bolts. Removing the anchor bolts without supporting is extremely hazardous and may result in fall of the Manipulator. |
|--|--|

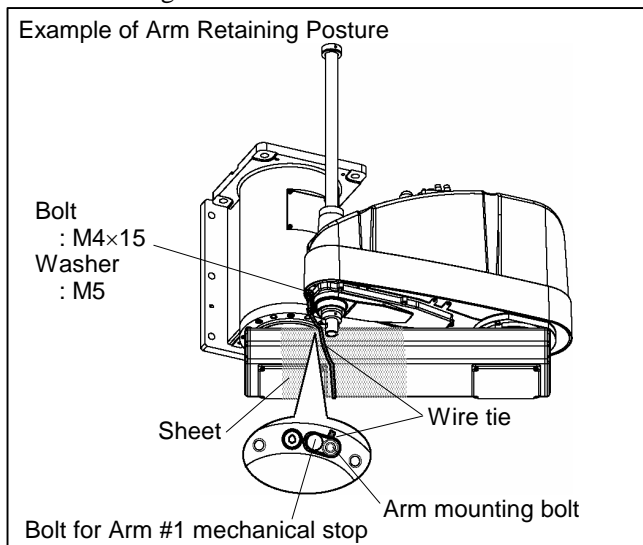
- (1) Turn OFF the power on all devices and unplug the cables.



Remove the mechanical stops if using them to limit the motion range of Joints #1 and #2. For details on the motion range, refer to *Setup & Operation: 5.2 Motion Range Setting by Mechanical Stops*.


- (2) Cover the arm with a sheet so that the arm will not be damaged.

Refer to the figure below and bind the shaft and arm retaining bracket on the base.



- (3) Hold the bottom of Arm #1 by hand to unscrew the anchor bolts. Then, remove the Manipulator from the wall.

3.8.4 Ceiling Mounting

| | |
|---|--|
|  WARNING | <ul style="list-style-type: none"> ■ Install or relocate the Ceiling Mounting Manipulator with four or more people. The Manipulator weights are as follows. Be careful not to get hands, fingers, or feet caught and/or have equipment damaged by a fall of the Manipulator. <ul style="list-style-type: none"> G10-65**R : Approximately 46 kg :102 lb. G10/G20-85**R : Approximately 48 kg :106 lb. G20-A0**R : Approximately 50 kg :111 lb. ■ When removing the Manipulator from the ceiling, support the Manipulator, and then remove the anchor bolts. Removing the anchor bolts without supporting is extremely hazardous and may result in fall of the Manipulator. |
|---|--|

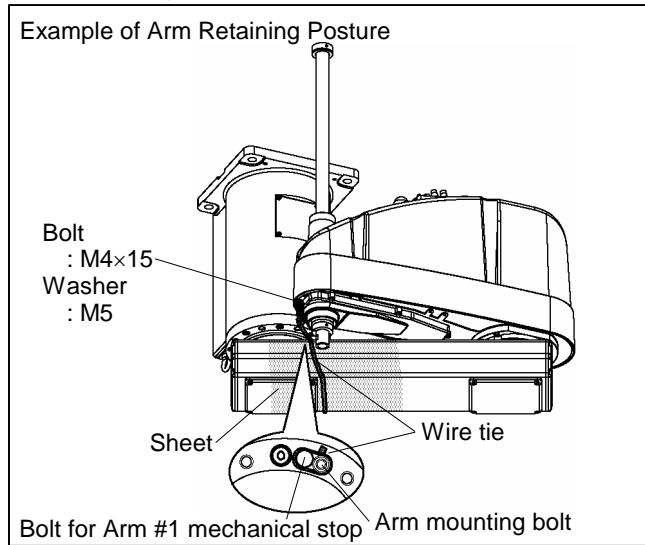
- (1) Turn OFF the power on all devices and unplug the cables.

NOTE


Remove the mechanical stops if using them to limit the motion range of Joints #1 and #2. For details on the motion range, refer to *Setup & Operation: 5.2 Motion Range Setting by Mechanical Stops*.

- (2) Cover the arm with a sheet so that the arm will not be damaged.

Refer to the figure below and bind the shaft and arm retaining bracket on the base.




- (3) Hold the bottom of Arm #1 by hand to unscrew the anchor bolts. Then, remove the Manipulator from the ceiling.

4. Setting of End Effectors

4.1 Attaching an End Effector

Users are responsible for making their own end effector(s). Before attaching an end effector, observe these guidelines.

| | |
|--|--|
|  CAUTION | <ul style="list-style-type: none"> ■ If you use an end effector equipped with a gripper or chuck, connect wires and/or pneumatic tubes properly so that the gripper does not release the work piece when the power to the robot system is turned OFF. Improper connection of the wires and/or pneumatic tubes may damage the robot system and/or work piece as the work piece is released when the Emergency Stop switch is pressed. I/O outputs are configured at the factory so that they are automatically shut off (0) by power disconnection, the Emergency Stop switch, or the safety features of the robot system. |
|--|--|

Shaft

- Attach an end effector to the lower end of the shaft.
For the shaft dimensions, and the overall dimensions of the Manipulator, refer to *Setup & Operation: 2. Specifications*.
- Do not move the upper limit mechanical stop on the lower side of the shaft. Otherwise, when “Jump motion” is performed, the upper limit mechanical stop may hit the Manipulator, and the robot system may not function properly.
- Use a split muff coupling with an M4 bolt or larger to attach the end effector to the shaft.

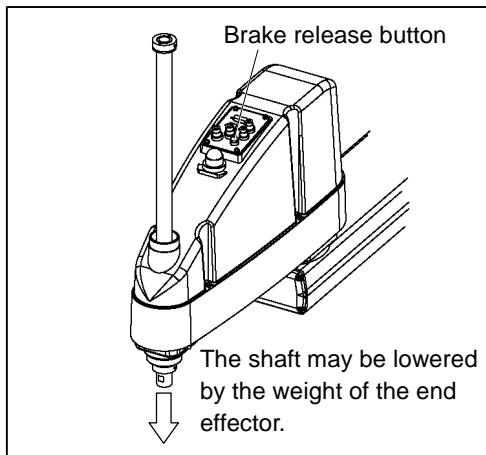
Brake release button

- Joints #3 and #4 cannot be moved up/down by hand because the electromagnetic brake is applied to the joints while power to the robot system is turned OFF. This prevents the shaft from hitting peripheral equipment and rotating in the case that the shaft is lowered by the weight of the end effector when the power is disconnected during operation, or when the motor is turned OFF even though the power is turned ON.

To move Joint #3 up/down or rotate Joint #4 while attaching an end effector, turn ON the Controller and move the joint up/down or rotate the joint while pressing the brake release button.

This button switch is a momentary-type; the brake is released only while the button switch is being pressed.

The respective brakes for Joints #3 and #4 are released simultaneously.



- Be careful of the shaft falling and rotating while the brake release button is being pressed because the shaft may be lowered by the weight of the end effector.

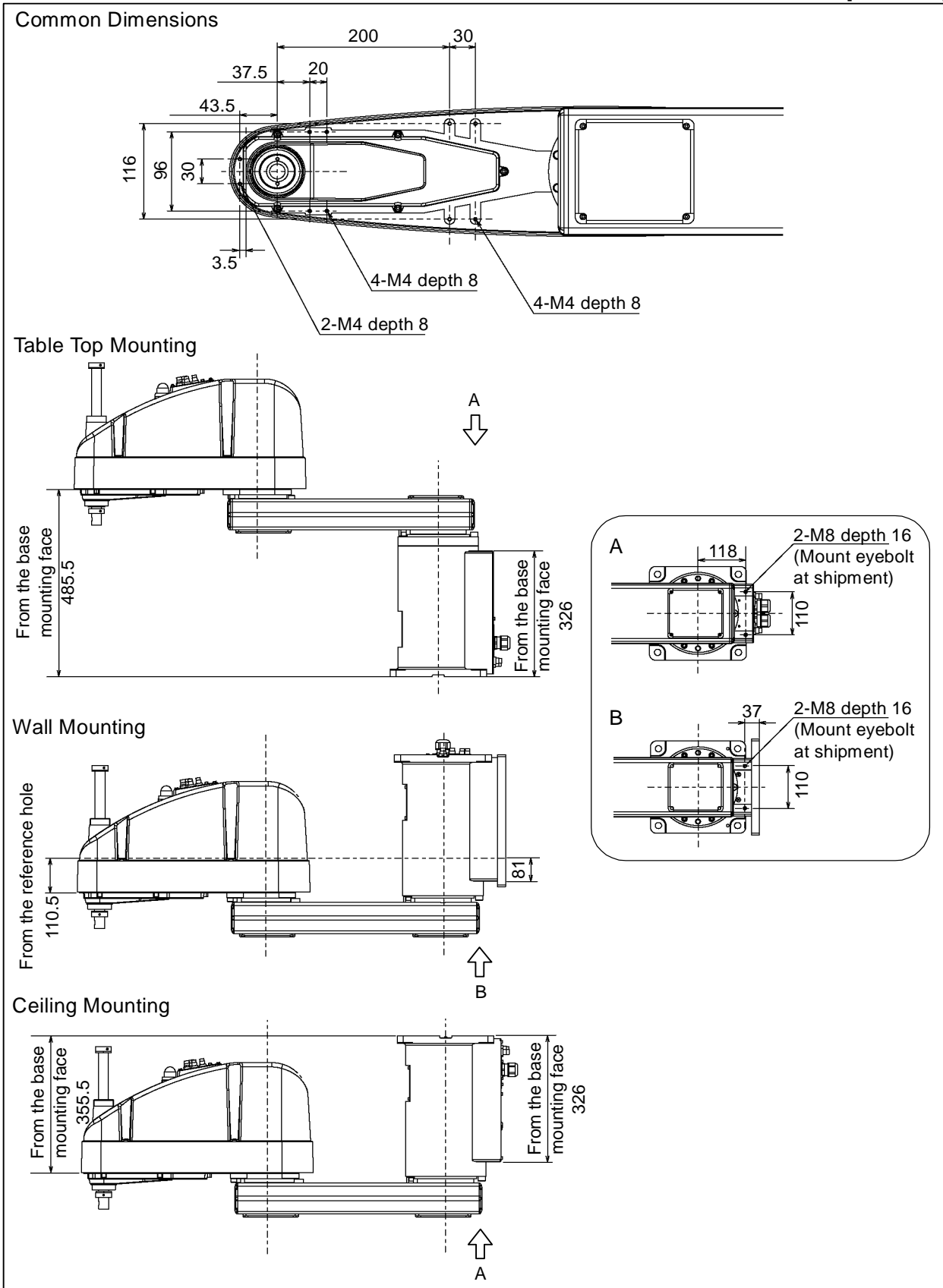
Layouts

- When you operate the manipulator with an end effector, the end effector may interfere with the Manipulator because of the outer diameter of the end effector, the size of the work piece, or the position of the arms. When designing your system layout, pay attention to the interference area of the end effector.

4.2 Attaching Cameras and Valves

Arm #2 has threaded holes as shown in the figure below. Use these holes for attaching cameras, valves, and other equipment.

[Unit: mm]




4.3 Weight and Inertia Settings

To ensure optimum Manipulator performance, it is important to make sure that the load (weight of the end effector and work piece) and moment of inertia of the load are within the maximum rating for the Manipulator, and that Joint #4 does not become eccentric.

If the load or moment of inertia exceeds the rating or if the load becomes eccentric, follow the steps below, “4.3.1 Weight Setting” and “4.3.2 Inertia Setting” to set parameters.

Setting parameters makes the operation of the Manipulator optimal, reduces vibration to shorten the operating time, and improves the capacity for larger loads. In addition, it reduces persistent vibration produced when the moment of inertia of the end effector and work piece is larger than the default setting.

4.3.1 Weight Setting

| | |
|---|--|
|  CAUTION | <ul style="list-style-type: none"> ■ G10 series The total weight of the end effector and the work piece must not exceed 10 kg. The G10 series Manipulators are not designed to work with loads exceeding 10 kg. G20 series The total weight of the end effector and the work piece must not exceed 20 kg. The G20 series Manipulators are not designed to work with loads exceeding 20 kg. <p>Always set the Weight parameters according to the load. Setting a value that is smaller than the actual load may cause errors, excessive shock, insufficient function of the Manipulator, and/or shorten the life cycle of parts/mechanisms.</p> |
|---|--|

The acceptable weight capacity (end effector and work piece) in G10 series and G20 series Manipulators are as follows.

| | Rated | Max. |
|------------|-------|-------|
| G10 series | 5 kg | 10 kg |
| G20 series | 10 kg | 20 kg |

When the load (weight of the end effector and work piece) exceeds the rating, change the setting of Weight parameter.

After the setting is changed, the maximum acceleration/deceleration speed of the robot system corresponding to the “Weight Parameter” is set automatically.

Load on the Shaft

The load (weight of the end effector and work piece) on the shaft can be set by Weight parameter.

**EPSON
RC+**

Enter a value into the [Load inertia:] text box on the [Inertia] panel ([Tools] - [Robot Manager]). (You may also execute the Inertia command from the [Command Window].)

Load on the Arm

When you attach a camera or other devices to the arm, calculate the weight as the equivalent of the shaft. Then, add this to the load and enter the total weight to the Weight parameter.

Equivalent Weight Formula

When you attach the equipment near Arm #2: $W_M = M (L_1)^2 / (L_1 + L_2)^2$

When you attach the equipment to the end of Arm #2: $W_M = M (L_M)^2 / (L_2)^2$

W_M : equivalent weight

M : weight of camera etc.

L_1 : length of Arm #1

L_2 : length of Arm #2

L_M : distance from rotation center of Joint #2 to center of gravity of camera etc.

<Example> A “1 kg” camera is attached to the end of the G10 series arm (450 mm away from the rotation center of Joint #2) with a load weight of “2 kg”.

$$M = 1$$

$$L_2 = 400$$

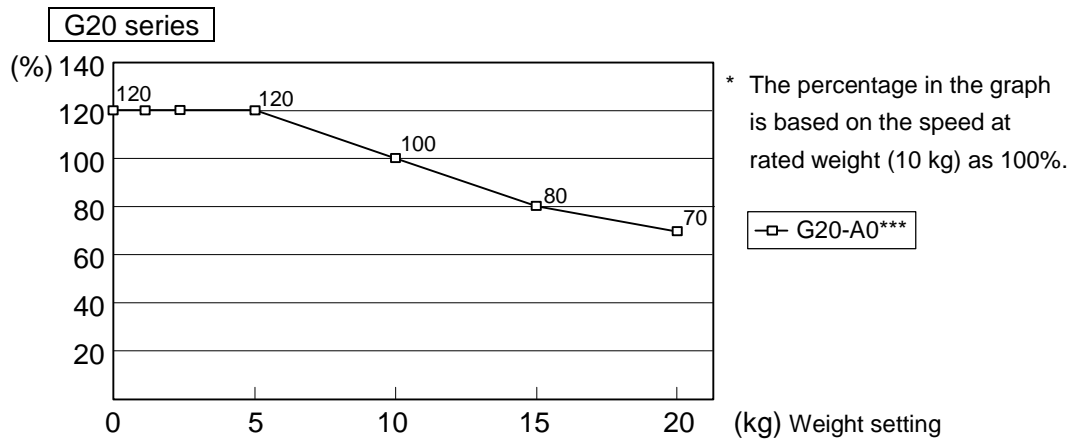
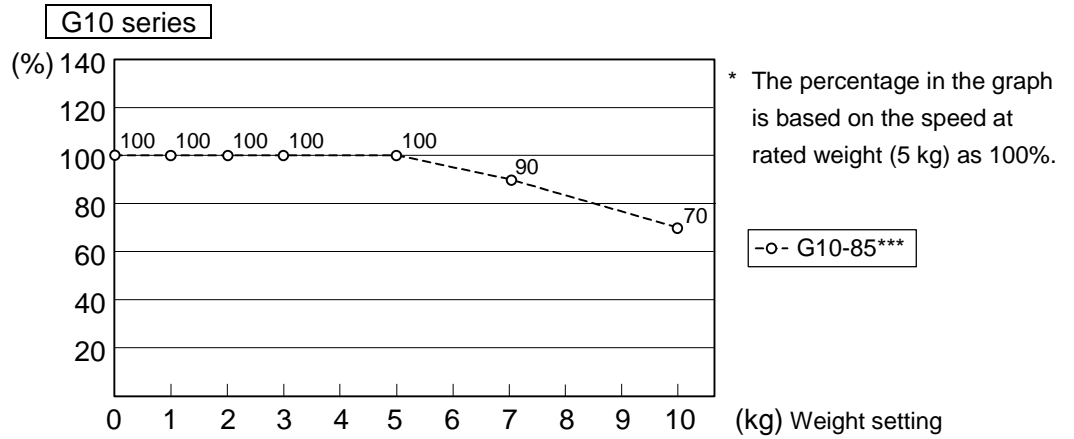
$$L_M = 450$$

$$W_M = 1 \times 450^2 / 400^2 = 1.26 \rightarrow 1.3 \text{ (round up)}$$

$$W + W_M = 2 + 1.3 = 3.3$$

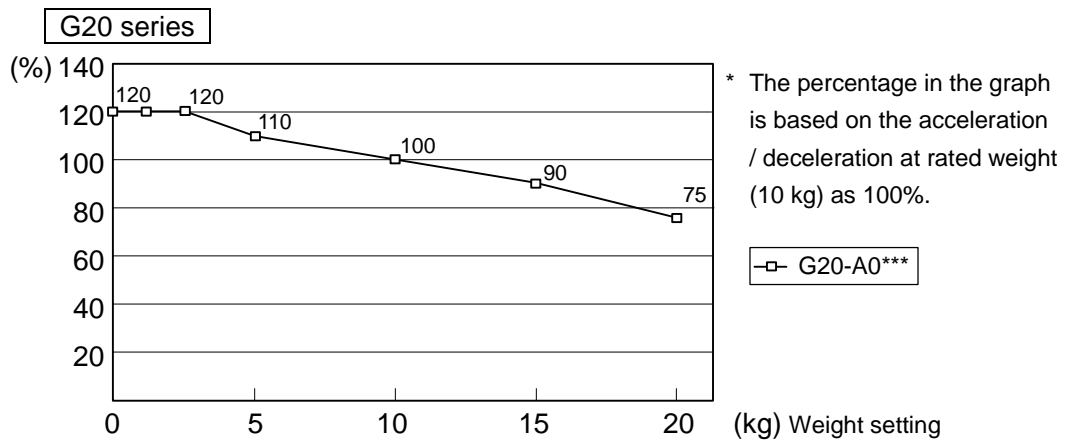
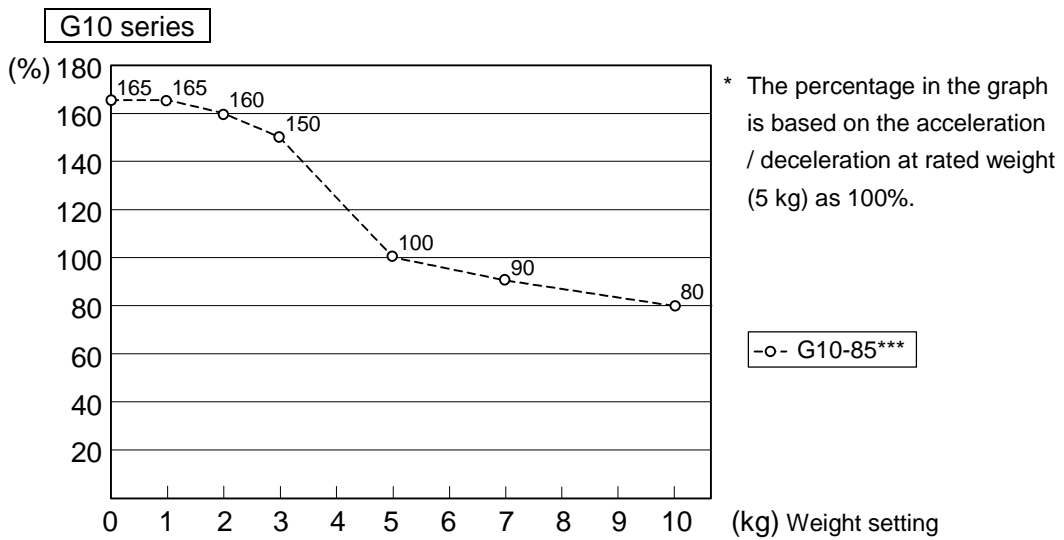
Enter “3.3” for the Weight Parameter.

Automatic speed setting by Weight



Contact us for details of G10-65*** and G20-85***.

Automatic acceleration/deceleration setting by Weight




Contact us for details of G10-65*** and G20-85***.

4.3.2 Inertia Setting

Moment of Inertia and the Inertia Setting

The moment of inertia is defined as “the ratio of the torque applied to a rigid body and its resistance to motion”. This value is typically referred to as “the moment of inertia”, “inertia”, or “ GD^2 ”. When the Manipulator operates with additional objects (such as an end effector) attached to the shaft, the moment of inertia of load must be considered.

| | |
|---|---|
|  CAUTION | <p>■ G10 series The moment of inertia of the load (weight of the end effector and work piece) must be $0.25 \text{ kg}\cdot\text{m}^2$ or less. The G10 series Manipulators are not designed to work with a moment of inertia exceeding $0.25 \text{ kg}\cdot\text{m}^2$.</p> <p>G20 series The moment of inertia of the load (weight of the end effector and work piece) must be $0.45 \text{ kg}\cdot\text{m}^2$ or less. The G20 series Manipulators are not designed to work with a moment of inertia exceeding $0.45 \text{ kg}\cdot\text{m}^2$.</p> <p>Always set the moment of inertia parameter to the correct moment of inertia. Setting a value that is smaller than the actual moment of inertia may cause errors, excessive shock, insufficient function of the Manipulator, and/or shorten the life cycle of parts/mechanisms.</p> |
|---|---|

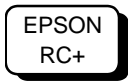
The acceptable moment of inertia of load for a G10 series and G20 series Manipulators are as follows.

| | Rated | Max. |
|------------|----------------------------------|----------------------------------|
| G10 series | $0.02 \text{ kg}\cdot\text{m}^2$ | $0.25 \text{ kg}\cdot\text{m}^2$ |
| G20 series | $0.05 \text{ kg}\cdot\text{m}^2$ | $0.45 \text{ kg}\cdot\text{m}^2$ |

When the moment of inertia of the load exceeds the rating, change the setting of the moment of inertia parameter of the Inertia command. After the setting is changed, the maximum acceleration/deceleration speed of Joint #4 corresponding to the “moment of inertia” value is set automatically.

Moment of inertia of load on the shaft

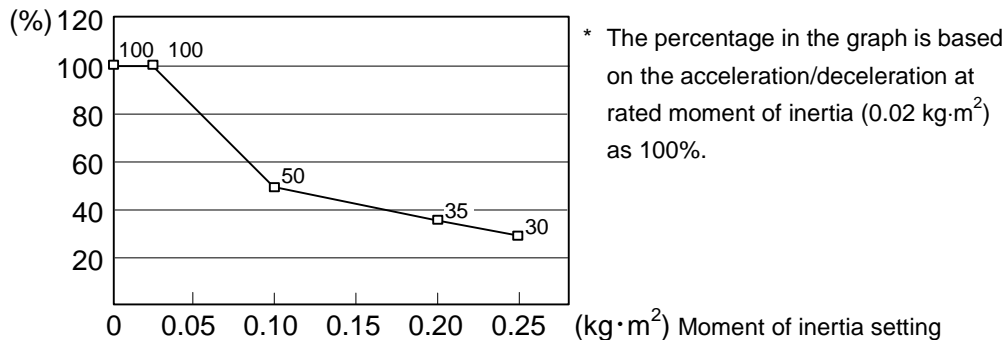
The moment of inertia of load (weight of the end effector and work piece) on the shaft can be set by the “moment of inertia” parameter of the Inertia command.



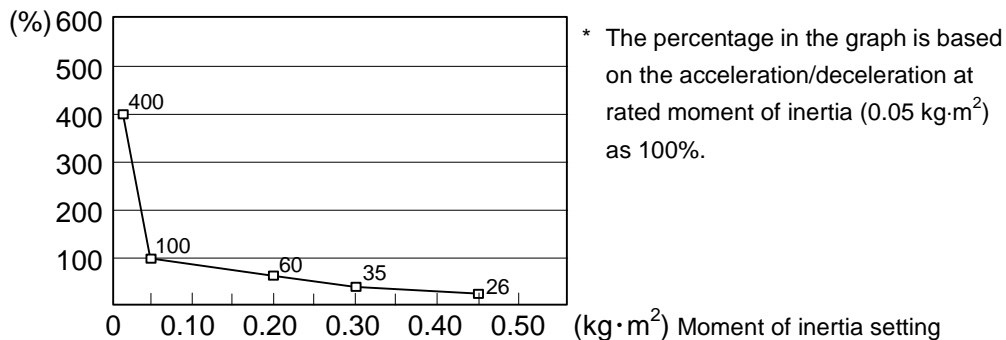
Enter a value into the [Load inertia:] text box on the [Inertia] panel ([Tools]-[Robot Manager]). (You may also execute the Inertia command from the [Command Window].)

Automatic acceleration/deceleration setting of Joint #4 by Inertia (moment of inertia)


G10 series



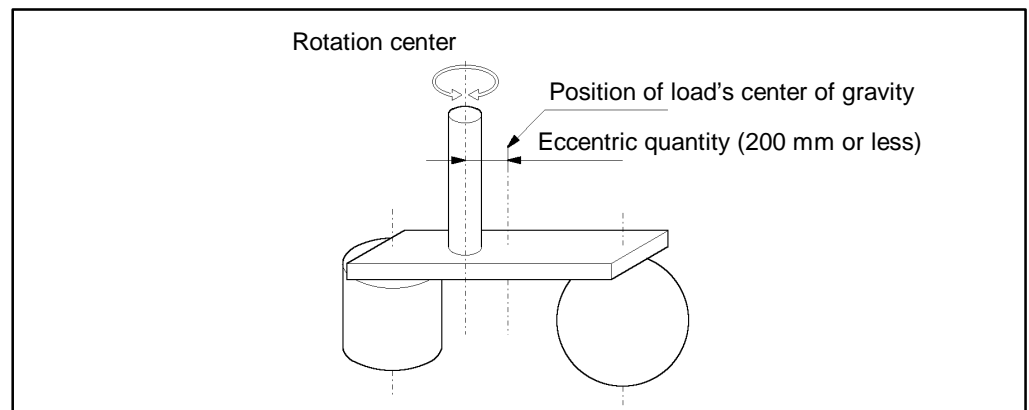
G20 series



Eccentric Quantity and the Inertia Setting

| | |
|---|--|
|  CAUTION | <ul style="list-style-type: none"> ■ The eccentric quantity of load (weight of the end effector and work piece) must be 200 mm or less. The G10 series and G20 series Manipulators are not designed to work with eccentric quantity exceeding 200 mm. Always set the eccentric quantity parameter according to the eccentric quantity. Setting a value that is smaller than the actual eccentric quantity may cause errors, excessive shock, insufficient function of the Manipulator, and/or shorten the life cycle of parts/mechanisms. |
|---|--|

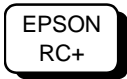
The acceptable eccentric quantity of load in G10 series and G20 series Manipulators is 0 mm at the default rating and 200 mm at the maximum. When the eccentric quantity of load exceeds the rating, change the setting of eccentric quantity parameter of Inertia command. After the setting is changed, the maximum acceleration/deceleration speed of the Manipulator corresponding to the “eccentric quantity” is set automatically.



Eccentric Quantity

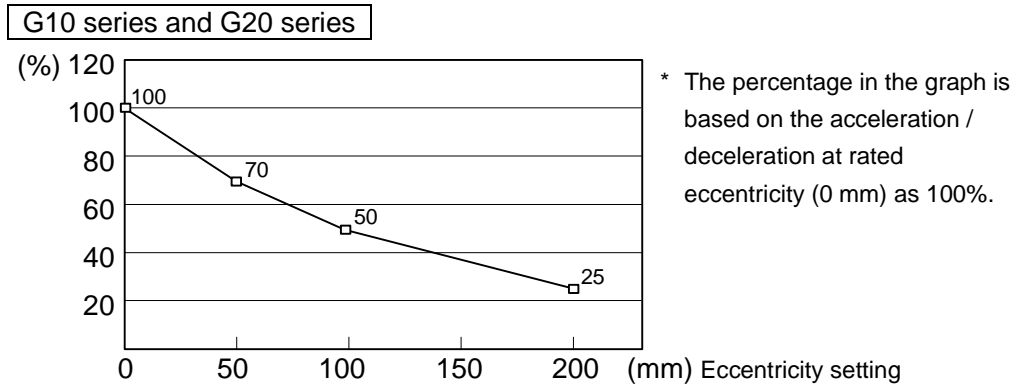
Eccentric quantity of load on the shaft

The eccentric quantity of load (weight of the end effector and work piece) on the shaft can be set by “eccentric quantity” parameter of Inertia command.



Enter a value into the [Eccentricity:] text box on the [Inertia] panel ([Tools]-[Robot Manager]). (You may also execute the Inertia command from the [Command Window].)

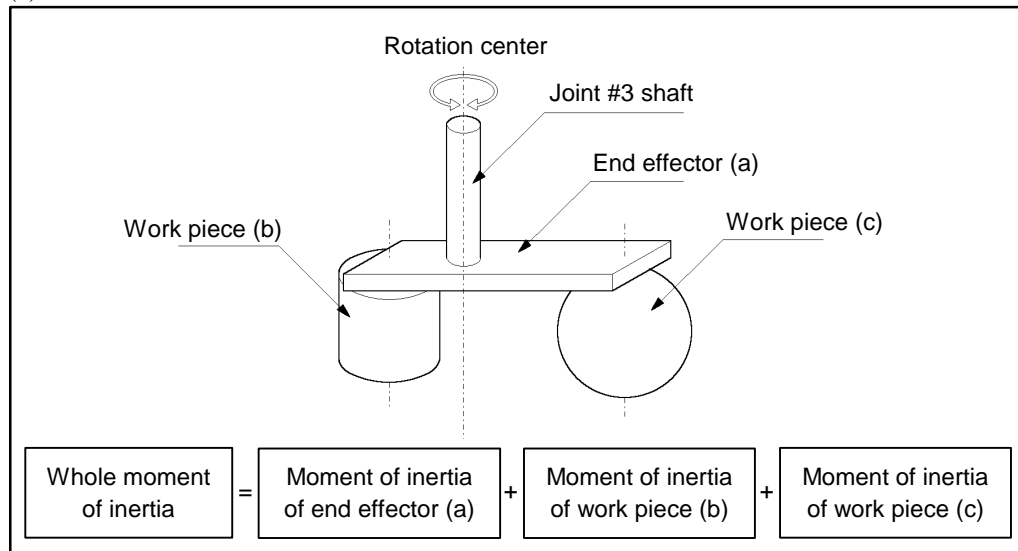
Automatic acceleration/deceleration setting by Inertia (eccentric quantity)



Calculating the Moment of Inertia

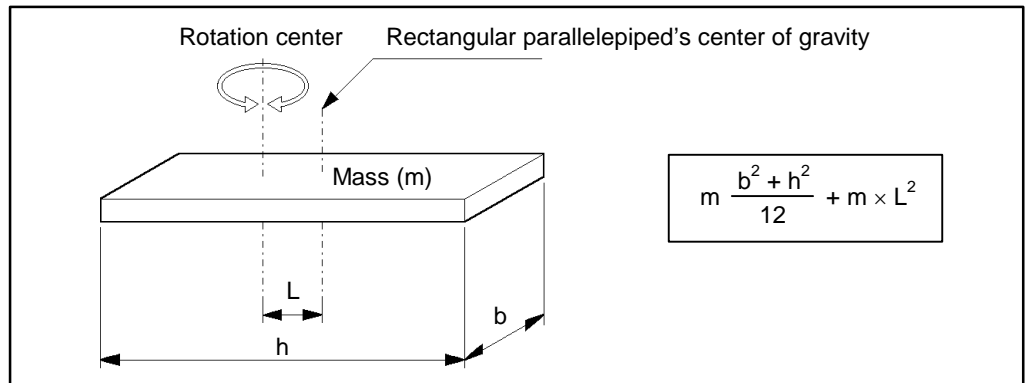
Refer to the following examples of formulas to calculate the moment of inertia of load (end effector with work piece).

The moment of inertia of the entire load is calculated by the sum of each part (a), (b), and (c).

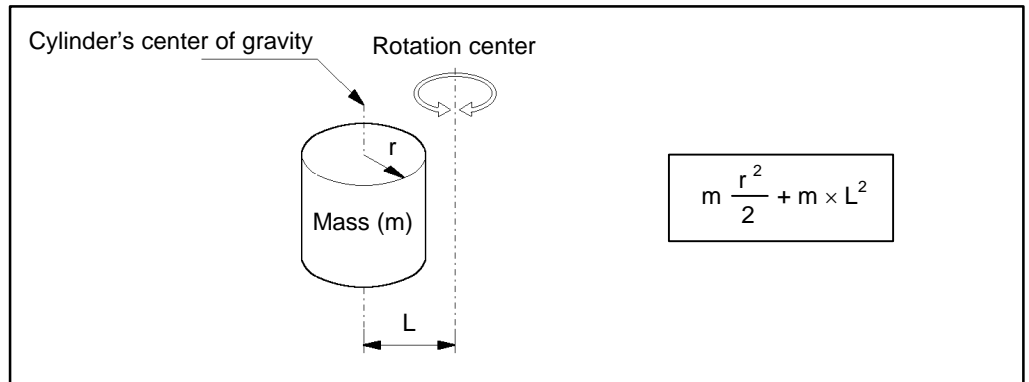


The methods for calculating the moment of inertia for (a), (b), and (c) are shown below. Calculate the total moment of inertia using the basic formulas.

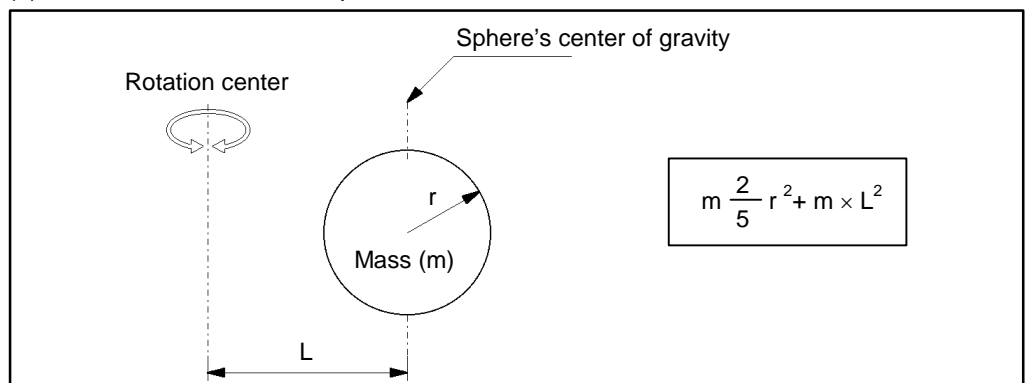
(a) Moment of inertia of a rectangular parallelepiped



(b) Moment of inertia of a cylinder



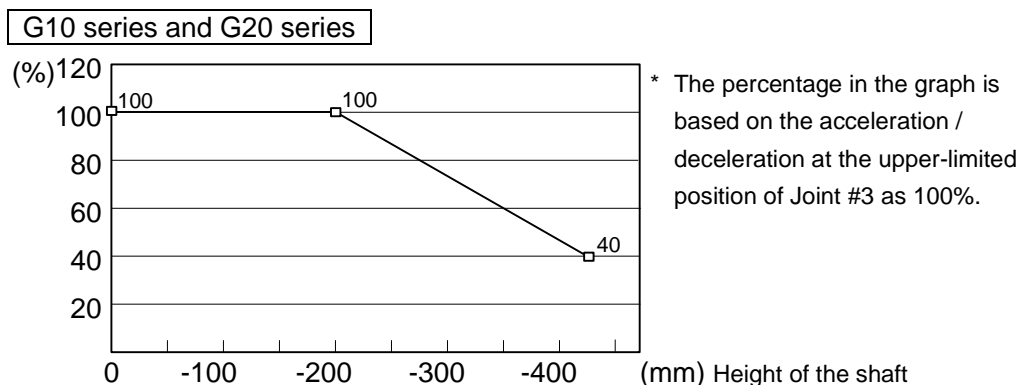
(c) Moment of inertia of a sphere




4.4 Precautions for Auto Acceleration/Deceleration of Joint #3

When you move the Manipulator horizontally with Joint #3 (Z) at a high position, the motion time will be faster. When Joint #3 gets below a certain point, then auto acceleration/deceleration is used to reduce acceleration/deceleration. (Refer to the figure below.) The higher the position of the shaft is, the faster the motion acceleration/deceleration is. However, it takes more time to move Joint #3 up and down. Adjust the position of Joint #3 for the Manipulator motion after considering the relation between the current position and the destination position. The upper limit of Joint #3 during horizontal motion can be set by the LimZ command.

Automatic acceleration/deceleration vs. Joint #3 position



NOTE  When moving the Manipulator horizontally while the shaft is being lowered, it may cause over-shoot at the time of final positioning.

5. Motion Range



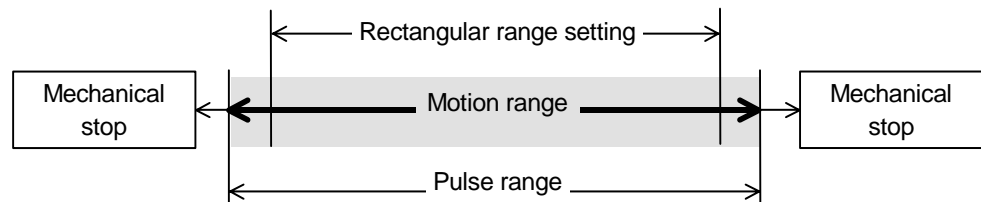
CAUTION

- When setting up the motion range for safety, both the pulse range and mechanical stops must always be set at the same time.

The motion range is preset at the factory as explained in *Setup & Operation: 5.4 Standard Motion Range*. That is the maximum motion range of the Manipulator.

There are three methods for setting the motion range described as follows:

1. Setting by pulse range (for all joints)
2. Setting by mechanical stops (for Joints #1 to #3)
3. Setting the Cartesian (rectangular) range in the X, Y coordinate system of the Manipulator (for Joints #1 and #2)



When the motion range is changed due to layout efficiency or safety, follow the descriptions in 5.1 to 5.3 to set the range.

5.1 Motion Range Setting by Pulse Range (for All Joints)

Pulses are the basic unit of Manipulator motion. The motion range of the Manipulator is controlled by the pulse range between the pulse lower limit and upper limit of each joint. Pulse values are read from the encoder output of the servo motor.

For the maximum pulse range, refer to the following sections.

The pulse range must be set inside of the mechanical stop range.

5.1.1 Max. Pulse Range of Joint #1

5.1.2 Max. Pulse Range of Joint #2

5.1.3 Max. Pulse Range of Joint #3

5.1.4 Max. Pulse Range of Joint #4.



Once the Manipulator receives an operating command, it checks whether the target position specified by the command is within the pulse range before operating. If the target position is out of the set pulse range, an error occurs and the Manipulator does not move.

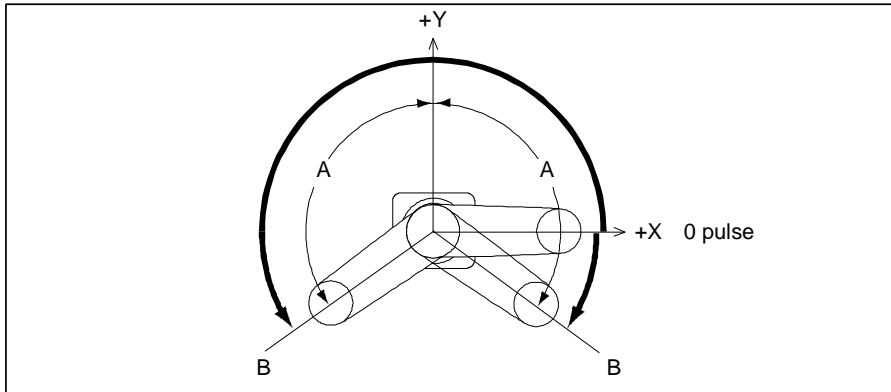


The pulse range can be set on the [Range] panel shown by selecting [Tools]-[Robot Manager]. (You may also execute the Range command from the [Command Window].)

5.1.1 Max. Pulse Range of Joint #1

The 0 (zero) pulse position of Joint #1 is the position where Arm #1 faces toward the positive (+) direction on the X-coordinate axis.

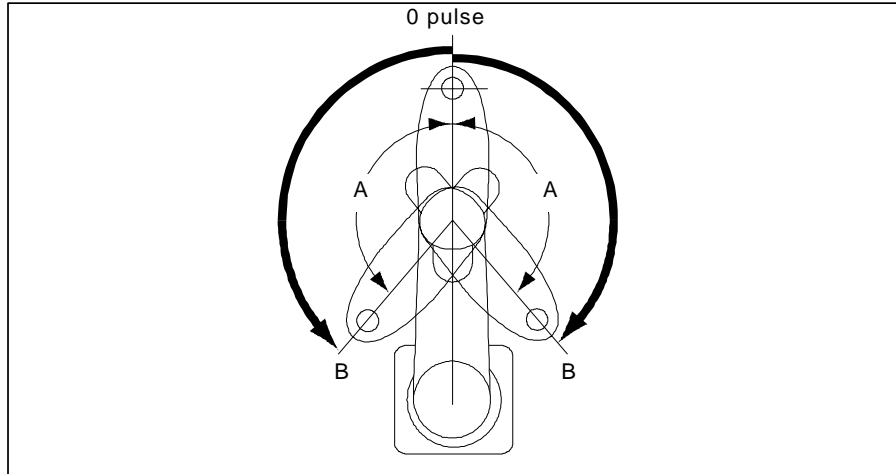
When the 0 pulse is a starting point, the counterclockwise pulse value is defined as the positive (+) and the clockwise pulse value is defined as the negative (-).



| | Arm length | Table Top Mounting | Ceiling Mounting | Wall mounting |
|------------------------|-------------|--------------------|------------------|---------------|
| A Max. Motion Range | 65 85/A0 | ±152 degrees | | ±107 degrees |
| B Max. Pulse Range | 65 85/A0 | | | |

5.1.2 Max. Pulse Range of Joint #2

The 0 (zero) pulse position of Joint #2 is the position where Arm #2 is in-line with Arm #1. With the 0 pulse as a starting point, the counterclockwise pulse value is defined as the positive (+) and the clockwise pulse value is defined as the negative (-).



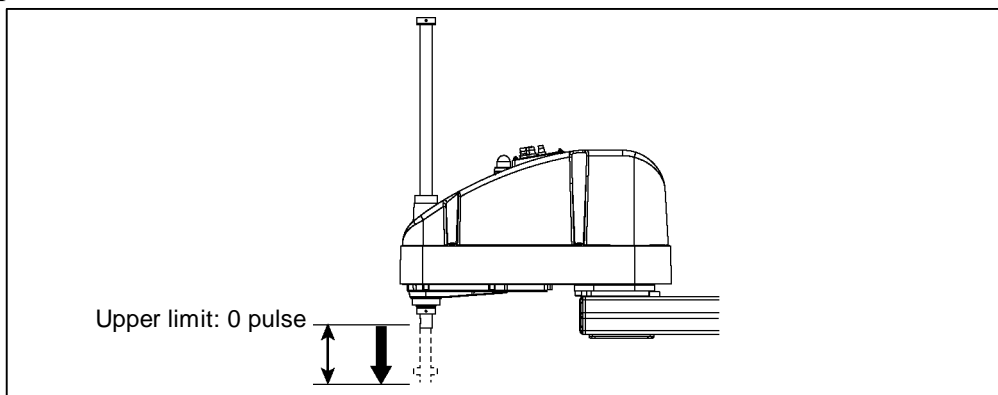
| | Model | Table Top Mounting | Ceiling / Wall Mountings |
|---------------------------|--|--------------------|--------------------------|
| A Max. Motion Range | G10-65*S* | | ±130 degrees |
| | G10 / G20-85*S* | ±152.5 degrees | ±152.5 degrees |
| | G10 / G20-85*C* Z: 0 to -360 Z: -360 to -390 | ±151 degrees | ±151 degrees |
| | G20-A0*S* | ±152.5 degrees | ±152.5 degrees |
| B Max. Pulse Range | G10-65*S* | | ±2366578 |
| | G10 / G20-85*S* | ±2776178 | ±2776178 |
| | G10 / G20-85*C* Z: 0 to -360 Z: -360 to -390 | ±2748871 | ±2748871 |
| | G20-A0*S* | ±2776178 | ±2776178 |

NOTE

 In the range Z: -360 to -390 mm, the area is limited by interference of the Manipulator body and the arm.

5.1.3 Max. Pulse Range of Joint #3

The 0 (zero) pulse position of Joint #3 is the position where the shaft is at its upper limit. The pulse value is always negative because Joint #3 always moves lower than the 0 pulse position.



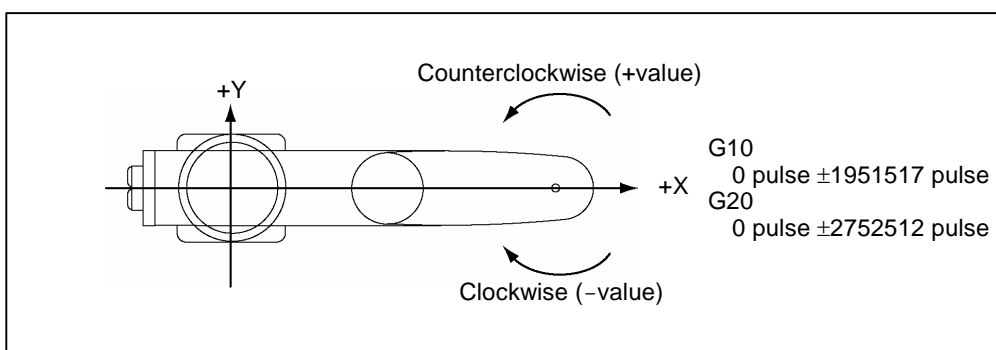
| Model | Joint #3 Stroke | Minimum Limit Pulse |
|---------------|-----------------|---------------------|
| G10/G20-**1S* | 180 mm | -1946420 |
| G10/G20-**4S* | 420 mm | -2270823 |
| G10/G20-**1C* | 150 mm | -1622016 |
| G10/G20-**4C* | 390 mm | -2108621 |



NOTE For the Cleanroom-model (G10/G20-***C*), the motion range set with the Joint #3 mechanical stop cannot be changed.

5.1.4 Max. Pulse Range of Joint #4

The 0 (zero) pulse position of Joint #4 is the position where the flat near the end of the shaft faces toward the end of Arm #2. With the 0 pulse as a starting point, the counterclockwise pulse value is defined as the positive (+) and the clockwise pulse value is defined as the negative (-).



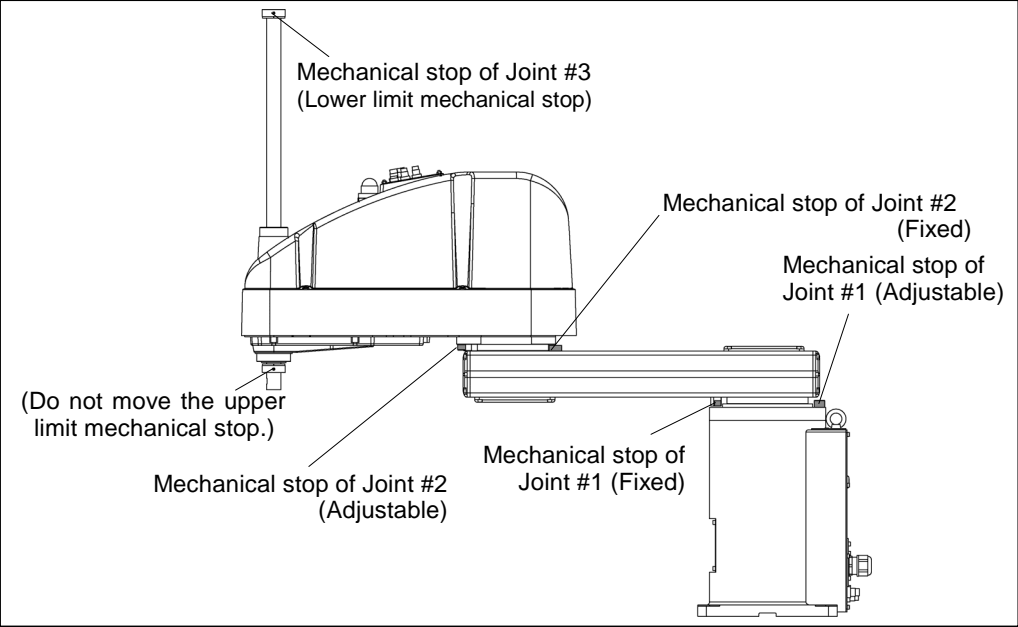
5.2 Motion Range Setting by Mechanical Stops

Mechanical stops physically limit the absolute area that the Manipulator can move.

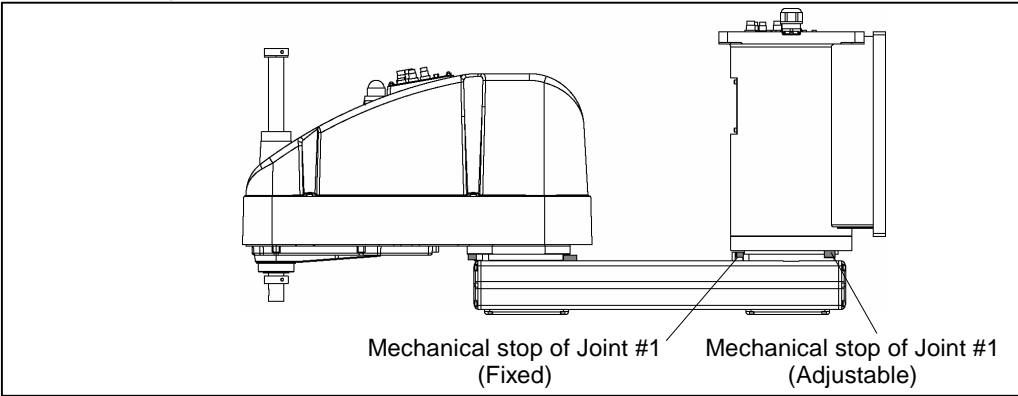
Both Joints #1 and #2 have threaded holes in the positions corresponding to the angle for the mechanical stop settings. Install the bolts in the holes corresponding to the angle that you want to set.

Joints #3 can be set to any length less than the maximum stroke.

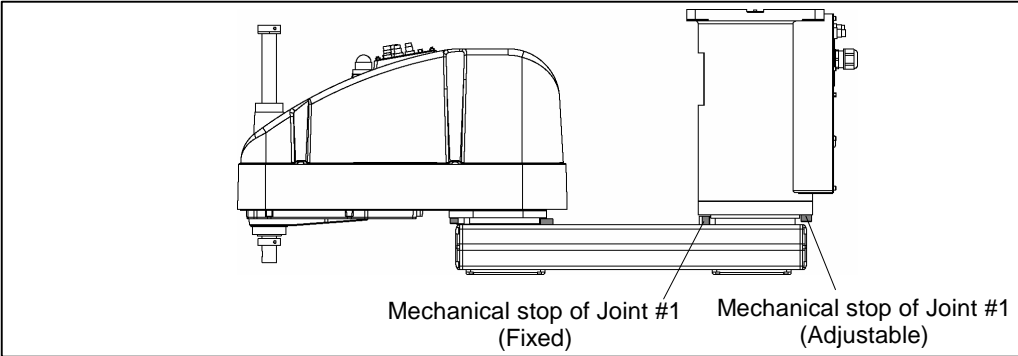
Table Top Mounting



Wall Mounting



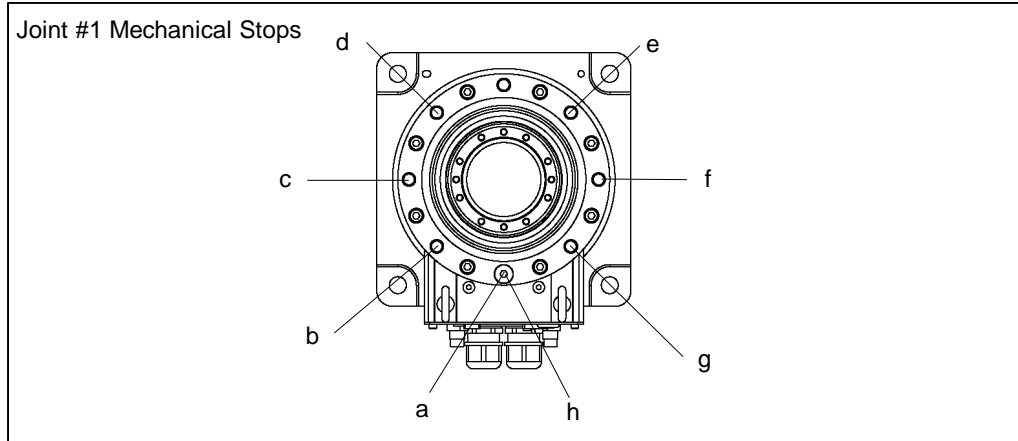
Ceiling Mounting



* The different mechanical stop positions from Table Top Mounting are indicated for Wall Mounting and Ceiling Mounting.

5.2.1 Setting the Mechanical Stops of Joints #1 and #2

Both Joints #1 and #2 have threaded holes in the positions corresponding to the angle for the mechanical stop settings. Install the bolts in the holes corresponding to the angle that you want to set.

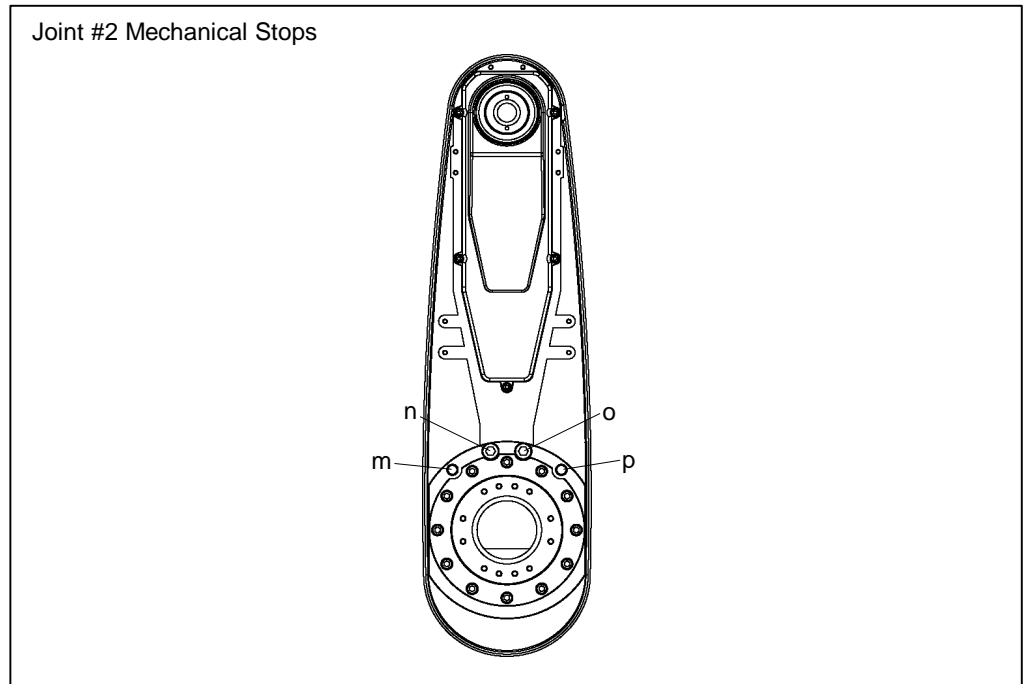


Joint #1

| Mounting | Arm Length | a | b | c | d | e | f | g | h |
|-----------|------------|-------|-------|------|------|------|------|-------|-------|
| Table Top | 65/85/A0 | +152° | +107° | +60° | +15° | -15° | -60° | -107° | -152° |
| Ceiling | 85/A0 | | | | | | | | |
| Ceiling | 65 | | | | | | | | |
| Wall | 65/85/A0 | | | | | | | | |

| | a | b | c | d | e | f | g | h |
|---------------|----------|----------|----------|----------|----------|---------|---------|----------|
| Setting Angle | +152° | +107° | +60° | +15° | -15° | -60° | -107° | -152° |
| Pulse Value | +7048761 | +5738041 | +4369067 | +3058347 | +2184534 | +873814 | -495161 | -1805881 |

(°: degree)




Joint #2

| Model | | Arm Length | m | n | o | q |
|----------------------------|-----------|------------|--------------|---------|---------|---------|
| Table Top / Ceiling / Wall | | A0 | +122.5° | +152.5° | -152.5° | -122.5° |
| Table Top | Standard | 85 | | | | |
| | Cleanroom | 85 | Z: 0 to -360 | +121° | +151° | -151° |
| Ceiling / Wall | Standard | 85 | +122.5° | +152.5° | -152.5° | -122.5° |
| | Cleanroom | 85 | +100° | +130° | -130° | -100° |
| Table Top | | 65 | +122.5° | +152.5° | -152.5° | -122.5° |
| Ceiling / Wall | | 65 | +100° | +130° | -130° | -100° |

| | | | | | |
|---------------|----------|----------|----------|----------|----------|
| Setting Angle | +100° | +121° | +122.5° | +151° | +152.5° |
| Pulse Value | +1820445 | +2202738 | +2230045 | +2748871 | +2776178 |
| Setting Angle | -152.5° | -151° | -122.5° | -121° | -100° |
| Pulse Value | -2776178 | -2748871 | -2230045 | -2202738 | -1820445 |

NOTE

(°: degree)

 In the range Z: -360 to -390 mm, the area is limited by interference of the Manipulator body and the arm.

- (1) Turn OFF the Controller.
- (2) Install a hexagon socket head cap bolt into the hole corresponding to the setting angle, and tighten it.

| Joint | Hexagon socket head cap bolt (fully threaded) | The number of bolts | Recommended tightening torque |
|-------|---|---------------------|-------------------------------|
| 1 | M12 × 20 | 1 | 12740 N·cm (1300 kgf·cm) |
| 2 | M10 × 10 | 2 | 7350 N·cm (750 kgf·cm) |

- (3) Turn ON the Controller.
- (4) Set the pulse range corresponding to the new positions of the mechanical stops. Be sure to set the pulse range inside the positions of the mechanical stop range.



Example: Using G10-854S
 The angle of Joint #1 is set from -105 degrees to +105 degrees.
 The angle of Joint #2 is set from -122.5 degrees to +122.5 degrees.



Execute the following commands from the [Command Window].

```
>JRANGE 1, -436907, 5679787 ' Sets the pulse range of Joint #1
>JRANGE 2, -2230045, 2230045 ' Sets the pulse range of Joint #2
>RANGE ' Checks the setting using Range
-436907, 5679787, -2230045, 2230045, -1976708
, 0, -1961226, 1961226
```

- (5) Move the arm by hand until it touches the mechanical stops, and make sure that the arm does not hit any peripheral equipment during operation.
- (6) Operate the joint changed at low speeds until it reaches the positions of the minimum and maximum pulse range. Make sure that the arm does not hit the mechanical stops. (Check the position of the mechanical stop and the motion range you set.)

Example: Using G10-854S
 The angle of Joint #1 is set from -105 degrees to +105 degrees.
 The angle of Joint #2 is set from -122.5 degrees to +122.5 degrees.



Execute the following commands from the [Command Window].

```
>MOTOR ON 'Turns ON the motor
>CP ON 'Enters low-power mode
>SPEED 5 'Sets at low speeds
>PULSE -436907, 0, 0, 0 'Moves to the min. pulse position of Joint #1
>PULSE 5679787, 0, 0, 0 'Moves to the max. pulse position of Joint #1
>PULSE 2621440, -2230045, 0, 0 'Moves to the min. pulse position of Joint #2
>PULSE 2621440, 2230054, 0, 0 'Moves to the max. pulse position of Joint #2
```

The Pulse command (Go Pulse command) moves all joints to the specified positions at the same time. Specify safe positions after considering motion of not only the joints whose pulse range have been changed, but also other joints.

In this example, Joint #1 is moved to the center of its motion range (pulse value: 2621440) when checking Joint #2.

If the arm is hitting the mechanical stops or if an error occurs after the arm hits the mechanical stops, either reset the pulse range to a narrower setting or extend the positions of the mechanical stops within the limit.

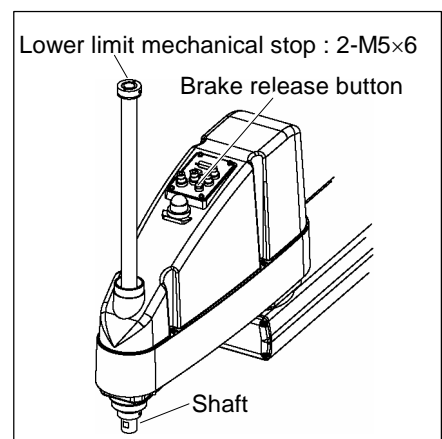
5.2.2 Setting the Mechanical Stop of Joint #3



This method applies only to the Standard-model Manipulator (G10/G20-***S*). For the Cleanroom-model (G10/G20-***C*), the motion range set with the Joint #3 mechanical stop cannot be changed.

- (1) Turn ON the Controller and turn OFF the motors using the Motor OFF command.
- (2) Push up the shaft while pressing the brake release button.

Do not push the shaft up to its upper limit or it will be difficult for the arm top cover to be removed. Push the shaft up to a position where the Joint #3 mechanical stop can be changed.



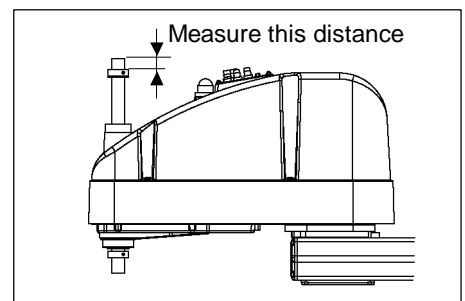
When you press the brake release button, the shaft may lower and rotate due to the weight of the end effector. Be sure to hold the shaft by hand while pressing the button.

- (3) Turn OFF the Controller.
- (4) Loosen the lower limit mechanical stop screw (2-M5×6).



A mechanical stop is mounted on both the top and bottom of Joint #3. However, only the position of the lower limit mechanical stop on the top can be changed. Do not remove the upper limit mechanical stop on the bottom because the calibration point of Joint #3 is specified using the stop.

- (5) The upper end of the shaft defines the maximum stroke. Move the lower limit mechanical stop down by the length you want to limit the stroke. For example, when the lower limit mechanical stop is set at “420 mm” stroke, the lower limit Z coordinate value is “-420”. To change the value to “-100”, move the lower limit mechanical stop down “330 mm”. Use calipers to measure the distance when adjusting the mechanical stop.



- (6) Firmly tighten two setscrews which are open at a 120 degree interval so that they do not enter the shaft groove.
Recommended tightening torque: 980 N·cm (100 kgf·cm)
- (7) Turn ON the Controller.
- (8) Move Joint #3 to its lower limit while pressing the brake release button, and then check the lower limit position. Do not lower the mechanical stop too far. Otherwise, the joint may not reach a target position.
- (9) Calculate the lower limit pulse value of the pulse range using the formula shown below and set the value.

The result of the calculation is always negative because the lower limit Z coordinate value is negative.

| |
|---|
| <p>G10-851S (Z: 180mm) Lower limit of pulse = lower limit Z coordinate value / 25 × 131072 × (66 / 32)</p> <p>G10-854S (Z: 420mm) Lower limit of pulse = lower limit Z coordinate value / 50 × 131072 × (66 / 32)</p> |
|---|

Example: When lowering the mechanical stop by 80 mm and changing the lower limit Z coordinate value to “-100” in 180 mm stroke
 $(-100) / 25 \times 131072 \times (66/32) = -1081344$



Execute the following command from the [Command Window].
>JRANGE 3, -1081344, 0 ' Sets the pulse range of Joint #3

Example: When lowering the mechanical stop by 330 mm and changing the lower limit Z coordinate value to “-100” in 420 mm stroke
 $(-100) / 50 \times 131072 \times (66/32) = -540672$



Execute the following command from the [Command Window].
>JRANGE 3, -540672, 0 ' Sets the pulse range of Joint #3

- (10) Using the Pulse command (Go Pulse command), move Joint #3 to the lower limit position of the pulse range at low speed. If the mechanical stop range is less than the pulse range, Joint #3 will hit the mechanical stop and an error will occur. When the error occurs, either change the pulse range to a lower setting or extend the position of the mechanical stop within the limit.



If it is difficult to check whether Joint #3 hits a mechanical stop, turn OFF the Controller and lift the arm top cover to check the condition causing the problem from the side.

Example: When lowering the mechanical stop by 80 mm and changing the lower limit Z coordinate value to “-100” in 180 mm stroke

EPSON
RC+

Execute the following commands from the [Command Window].

```
>MOTOR ON           ' Turns ON the motor
>SPEED 5           ' Sets low speed
>PULSE 0,0,-1081344,0 ' Moves to the lower limit-pulse position of Joint #3.
                        (In this example, all pulses except those for Joint #3
                        are “0”. Substitute these “0s” with the other pulse
                        values specifying a position where there is no
                        interference even when lowering Joint #3.)
```

Example: When lowering the mechanical stop by 320 mm and changing the lower limit Z coordinate value to “-100” in 420 mm stroke

EPSON
RC+

Execute the following commands from the [Command Window].

```
>MOTOR ON           ' Turns ON the motor
>SPEED 5           ' Sets low speed
>PULSE 0,0,-540672,0 ' Moves to the lower limit-pulse position of Joint #3.
                        (In this example, all pulses except those for Joint #3
                        are “0”. Substitute these “0s” with the other pulse
                        values specifying a position where there is no
                        interference even when lowering Joint #3.)
```

5.3 Setting the Cartesian (Rectangular) Range in the XY Coordinate System of the Manipulator (for Joints #1 and #2)

Use this method to set the upper and lower limits of the X and Y coordinates.

This setting is only enforced by software. Therefore, it does not change the physical range. The maximum physical range is based on the position of the mechanical stops.

EPSON
RC+

Set the XYLim setting on the [XYZ Limits] panel shown by selecting [Tools]-[Robot Manager].

(You may also execute the XYLim command from the [Command Window].)

5.4 Standard Motion Range

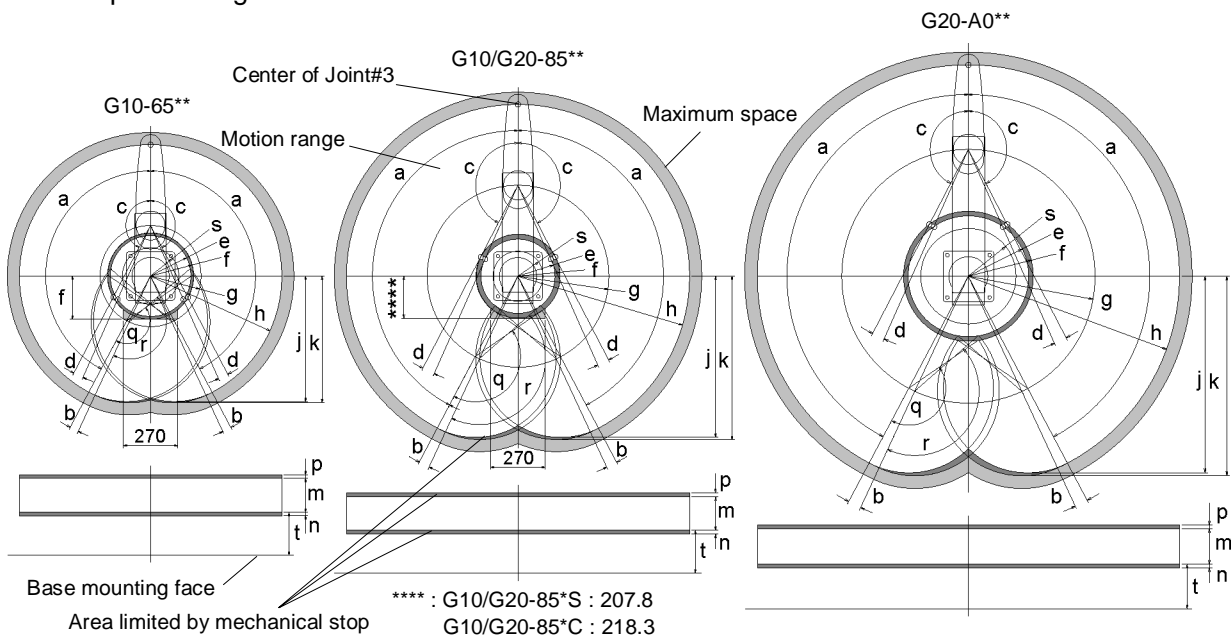
The following “motion range” diagrams show the standard (maximum) specification. When each Joint motor is under servo control, the center of Joint #3’s (shaft’s) lowest point moves in the areas shown in the figure.

“Area limited by mechanical stop” is the area where the center of Joint #3’s lowest point can be moved when each joint motor is not under servo control.

“Mechanical stop” sets the limited motion range so that the center of Joint #3 cannot move beyond the area mechanically.

“Maximum space” is the area that contains the farthest reach of the arms. If the maximum radius of the end effector is over 60 mm, add the “Area limited by mechanical stop” and “radius of the end effector”. The total value is specified as the maximum area.

Table Top Mounting



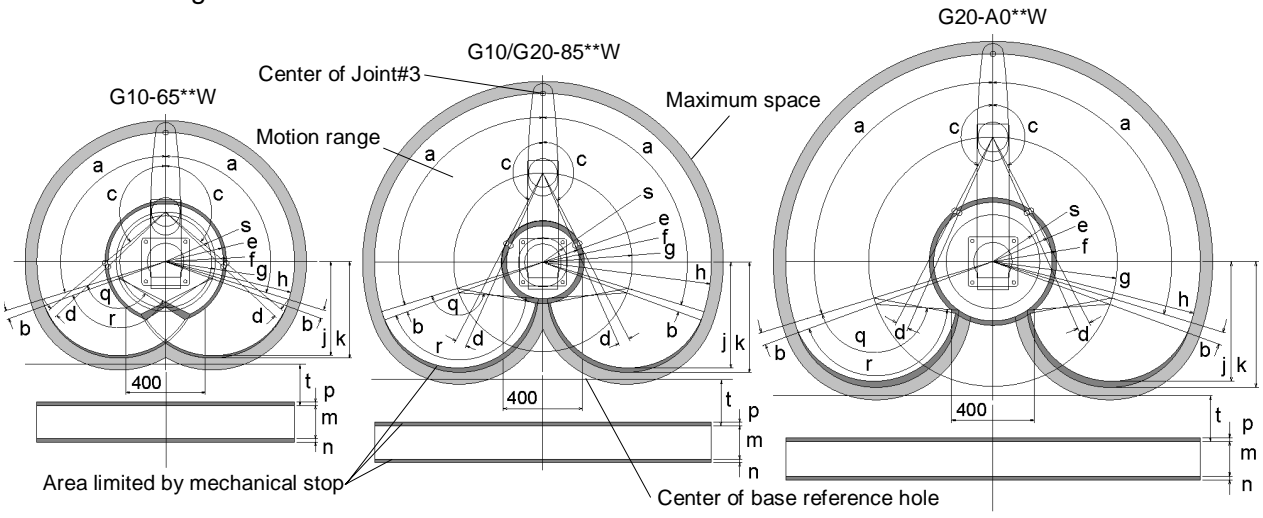
| | a | b | c | d | e | f | g | h | j | k | q | |
|--------------|------|----|-----------------|------|-------|-------|-----|------|-------|-------|-------|-----|
| G10-65** | 152° | 3° | 152.5° | 3.5° | 199.4 | 212.4 | 250 | 650 | 620.7 | 626.6 | 152.5 | |
| G10/G20-85*S | | | | | 183.3 | 207.8 | 450 | 850 | 797.3 | 807.8 | | |
| G10/G20-85*C | | | Z: 0 to -360 | 151° | 5° | 218.3 | | | | | | 151 |
| G10/G20-85*C | | | Z: -360 to -390 | | | | | | | | | |
| G20-A0** | | | 152.5° | 3.5° | 285.4 | 307 | 600 | 1000 | 929.8 | 943.8 | 152.5 | |

| | r | s |
|--------------|-----|-------|
| G10-65** | 156 | 139.4 |
| G10/G20-85** | | 123.3 |
| G20-A0** | | 225.4 |

| | m | n | p | t |
|--------------|-----|---|-----|-------|
| G10/G20-**1S | 180 | 5 | 5 | 393.5 |
| G10/G20-**4S | 420 | | | |
| G10/G20-**1C | 150 | 1 | 1.8 | 355.5 |
| G10/G20-**4C | 390 | | | |

NOTE (°: degree)
 In the range Z: -360 to -390 mm, the area is limited by interference of the Manipulator body and the arm.

Wall Mounting

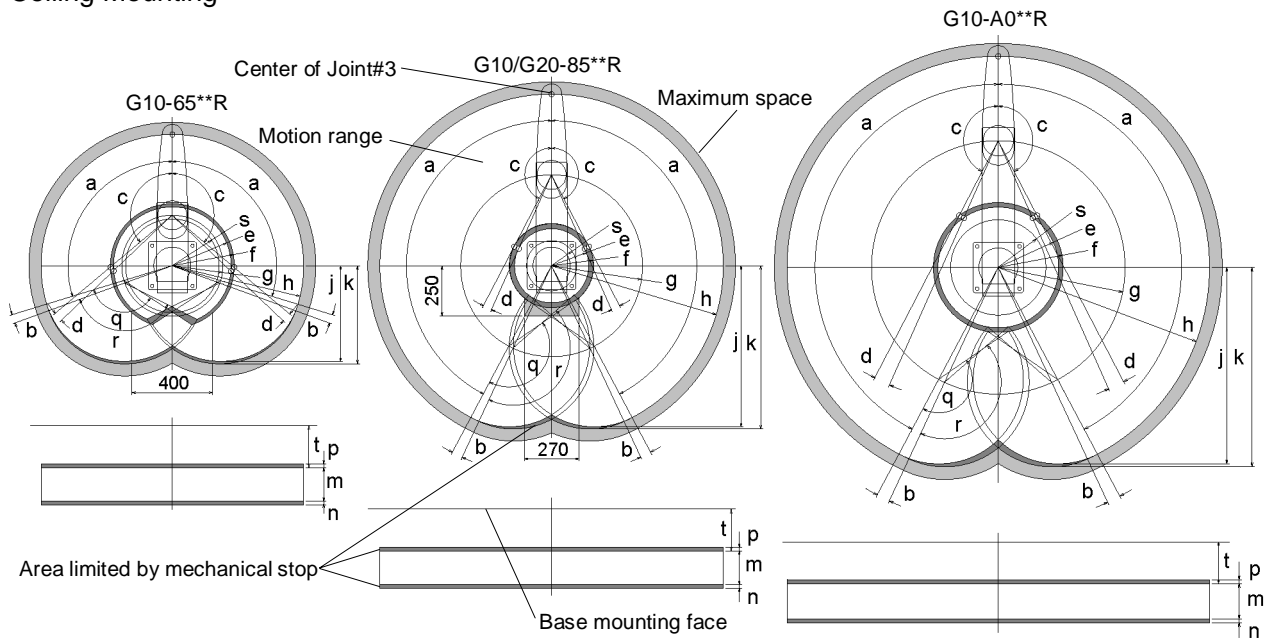


| | a | b | c | d | e | f | g | h | j | k | q | r | s |
|---------------|------|----|--------|------|-------|-------|-----|------|-------|-------|-------|-------|-------|
| G10-65**W | 107° | 3° | 130° | 3.5° | 291.2 | 306.5 | 250 | 650 | 473.1 | 485.5 | 130 | 133.5 | 231.2 |
| G10/G20-85*SW | | | 152.5° | | 183.3 | 207.8 | 450 | 850 | 531.6 | 553.9 | 152.5 | 156 | 123.3 |
| G10/G20-85*CW | | | 151° | 5° | 218.3 | 151 | | | | | | | |
| G20-A0**W | | | 152.5° | 3.5° | 285.4 | 307 | 600 | 1000 | 575.4 | 605.2 | 152.5 | 225.4 | |

| | m | n | p | t |
|---------------|-----|---|-----|-------|
| G10/G20-**1SW | 180 | 5 | 5 | 202.5 |
| G10/G20-**4SW | 420 | | | |
| G10/G20-**1CW | 150 | 1 | 1.8 | 240.5 |
| G10/G20-**4CW | 390 | | | |

(°: degree)

Ceiling Mounting



| | a | b | c | d | e | f | g | h | j | k | q | r | s |
|---------------|------|----|--------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|
| G10-65**R | 107° | 3° | 130° | 3.5° | 291.2 | 306.5 | 250 | 650 | 473.1 | 485.5 | 130 | 133.5 | 231.2 |
| G10/G20-85*SR | 152° | | 152.5° | | 5° | 183.3 | 207.8 | 450 | 850 | 797.3 | 807.8 | 152.5 | 156 |
| G10/G20-85*CR | | | 151° | 218.3 | | 151 | | | | | | | |
| G20-A0**R | | | 152.5° | 3.5° | 285.4 | 307 | 600 | 1000 | 929.8 | 943.8 | 152.5 | 225.4 | |

| | m | n | p | t |
|---------------|-----|---|-----|-------|
| G10/G20-**1SR | 180 | 5 | 5 | 447.5 |
| G10/G20-**4SR | 420 | | | |
| G10/G20-**1CR | 150 | 1 | 1.8 | 485.5 |
| G10/G20-**4CR | 390 | | | |

(°: degree)

6. Maintenance Parts List

Common Parts

| Part Name | | Code | Note | |
|----------------------|---------------------|---------------|---|---------------------------------------|
| AC Servo Motor | Joint #1 | R13B000610 | 750 W | |
| | Joint #2 | R13B000611 | 600 W | |
| | Joint #3 | R13B000607 | 400 W | |
| | Joint #4 | For G10 | R13B000612 | 150 W |
| | | For G20 | R13B000613 | 150 W with brake |
| Reduction Gear Unit | Joint #1 | R13B010013 | HD32-80 | |
| | Joint #2 | R13B010014 | HD32-50 | |
| | Joint #4 | For G10 | R13B031601 | G10-U |
| | | For G20 | R13B010015 | HPG-14A21 Planetary gear reduction |
| Cable Unit | 650 mm | R13B020014 | *3 | |
| | 850 mm | R13B020018 | Inner wiring cable | |
| | 1000 mm | R13B020019 | | |
| M/C Cable | Cable Length 3 m | R12B020425 | | |
| | Cable Length 5 m | R12B020426 | | |
| | Cable Length 10 m | R12B020427 | | |
| Solenoid Brake | Z axis | R13B030503 | | |
| | U axis | R13B030504 | G10 only | |
| Brake Release Switch | Joint #3, 4 | R13Z702640100 | *1 | |
| Timing Belt | Joint #3 | For G10 | R13B030209 | Z : width 12 mm 744-3GT |
| | | For G20 | R13B030211 | Z : width 12 mm 588-3GT |
| | Joint #4 | For G10 | R13B030210 | U1 : width 15 mm 375-3GT |
| | | For G20 | R13B030212 | U1 : width 20 mm 789-3GT |
| Battery Board | | R13B041202 | With lithium battery Installed in Arm #2 | |
| Battery Unit | | R13ZA00600300 | Lithium battery for replacement *2 | |
| O-ring | | R13B031228 | For Motor flange of Joint #1 | |
| LED Lamp | | R13A030000200 | *1 | |
| Grease | Ball Screw Spline | R13ZA00330200 | AFB grease (400 g) *1 | |
| | Reduction Gear Unit | R13ZA00330100 | SK-1A (500 g) *1 | |
| | Cable | R13B030304 | Tube of GPL-224 (227 g) | |

*1 Common with E2 series

*2 Common with E2C

*3 Common with G6 series

Parts by Environment Model

(S: Standard-model C: Cleanroom-model)

| Part Name | | | | Code | Note |
|-------------------|---------|---|------------|----------------|------|
| Ball Screw Spline | For G10 | S | 180 mm | R13B010208 | |
| | | | 420 mm | R13B010209 | |
| | | C | 150 mm | R13B010210 | |
| | | | 390 mm | R13B010211 | |
| | For G20 | S | 180 mm | R13B010214 | |
| | | | 420 mm | R13B010215 | |
| | | C | 150 mm | R13B010216 | |
| | | | 390 mm | R13B010217 | |
| Arm Cover | | S | R13B030410 | White painting | |
| | | C | R13B030414 | Plating | |
| Bellows | | C | 150 mm | R13B030701 | *3 |
| | | | 390 mm | R13B030703 | |

*3 Common with G6 series